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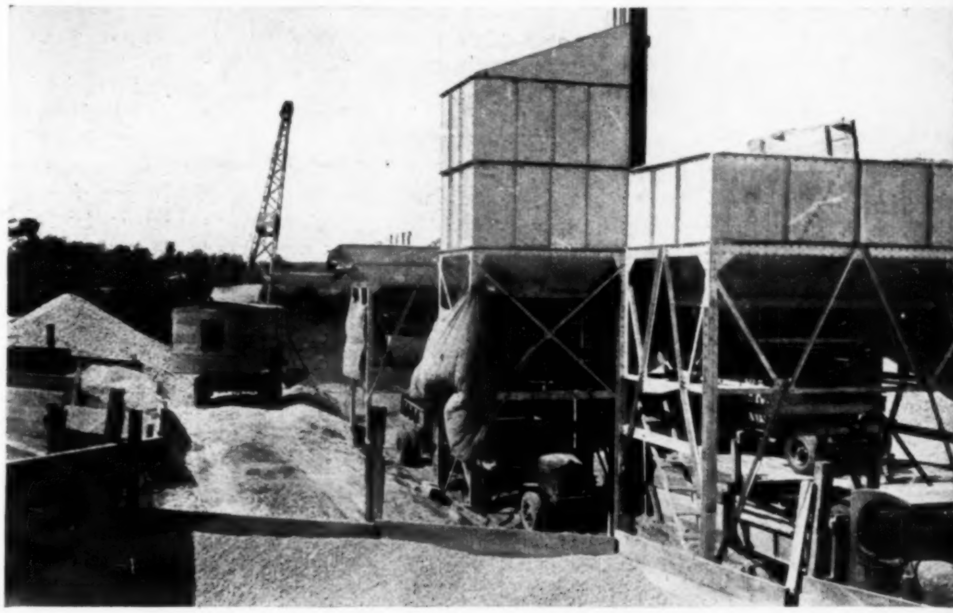
Batching PLANT Operation



Straight Line Batching Plant Layout. Note Boarded Stock Piles and Cement Bin Located Between Aggregate Bins

Employing One, Two and Three Sizes of Coarse Aggregate

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COARSE aggregate in two or three separate sizes for Portland cement concrete paving is now required in several states. Thus, for example, Wisconsin requires the coarse aggregate to be separated into two sizes when the maximum size is 1½ inches and into three sizes when the maximum size is 2½ inches. This separation of sizes is intended to eliminate as much as possible such segregation as may take place in car delivery and in stock piling, and thus secure a more uniform gradation of the coarse aggregates and so help to reduce the batch-to-batch variations.

An analysis of the operation of many batching plants handling multiple and single sizes of coarse aggregates leads to the following conclusions: (1) that one 2-compartment bin should be used where only one size of coarse aggregate is required; (2) that one 3-compartment bin should be used where two sizes of coarse aggregate are required, and (3) that two 2-compartment bins should be used where three sizes of coarse aggregate are required.

Whenever the proper plant layout can be secured, only one crane will be necessary to supply the bins for a 27E paver using either one, two or three sizes of coarse aggregate. The area of the batching plant site must, however, of necessity be larger for handling multiple sizes of coarse aggregate in order to provide room for the extra stock piles, even though this be kept at a minimum by the use of planking. The cost of handling multiple sizes of coarse aggregate at the batching plant should therefore be limited to the cost of the larger or additional bin and its operator. The cost of the bin, for one size of coarse aggregate and the sand, is approximately $2,000. The cost of a 3-compartment bin, to handle two sizes of coarse aggregate and the sand, is approximately $2,900. For three sizes of coarse aggregate and sand, two 2-compartment bins will cost approximately $4,000.

The number of trucks required to handle the multiple sizes will, of course, have to be increased as the amount of time spent at the batching plant increases. The following simple equation is given to compute the number of trucks that will have to be added as the amount of time spent at the batching plant increases:

Let T' = the additional time in minutes that each truck is required to spend at the batching plant.

t = the mixer cycle in minutes.

n = the number of batches per truck.

N = the number of extra trucks required due to the additional time spent at the batching plant.

Then $N = \dfrac{T'}{nt}$

If the mixer cycle is 73 seconds, then according to this

formula 0.82 one-batch truck, 0.41 two-batch truck, or 0.272 three-batch truck will have to be added to supply the mixer with materials for maximum production for every additional minute spent at the batching plant by each truck. According to this formula one full truck has to be added when the time spent at the plant is lengthened by the product of the mixer cycle times the number of batches carried per truck. Thus, for a mixer cycle of 73 seconds, one additional truck has to be added when the time spent at the loading plant is increased 73, 146 and 219 seconds for one-batch, two-batch, and three-batch trucks, respectively.

Turning and backing a truck under a bin requires from 20 to 30 seconds. Good management, therefore, requires that the batching plant be so planned and laid out that the trucks can drive through the bin or bins without turning or backing. This will save approximately 20 to 30 seconds for a one-bin layout and from 40 to 60 seconds when a two-bin layout is required.

During the past three seasons detailed studies have been made of a number of batching plants in which special attention was given to the effect on operating efficiency of such features as yard layout and methods of operation. These studies include plants located at railroad sidings, plants located at local producing plants, as well as plants located so that all materials were brought in by truck haul. Most of the jobs also used bulk cement, which the batch trucks generally carried either on top of each batch, lightly covered by sand or aggregate, or else where two aggregate bins were used, dumped between the aggregates from the first and second bin. This latter method proved very fast, efficient and satisfactory.

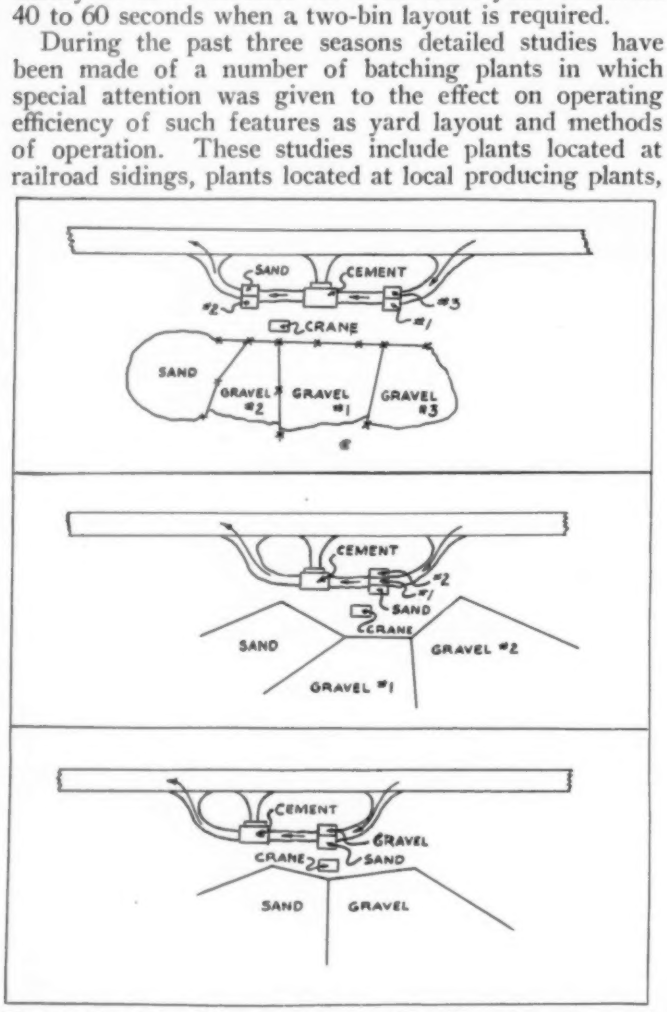

Fig. 1.—Batching Plant Layouts for Handling One, Two and Three Sizes of Coarse Aggregate When Aggregates Are Hauled in by Truck or Batching Plant is Set Up at Local Producing Plant

As a result of the data and experience secured during these studies two general types of batching plant layouts are recommended for use in connection with one, two and three sizes of coarse aggregates. These are shown in general outline in Figures 1 and 2. The type of layout shown in Figure 1 is adapted to locations where all the materials are, brought to the plant by truck haul or when the batcher set-up is at a local producing plant, while the type of layout shown in Figure 2 is more especially adapted to locations at railroad sidings.

Tables I and II show the average operating characteristics for two-batch trucks for each of the layouts represented in Figures 1 and 2, respectively it is interesting to note in Table I that when the bulk cement is handled as there indicated, then the time which each truck of any given size will require to pass through the yard will be approximately the same regardless of whether the job uses one, two or three sizes of coarse aggregate. The reason for this is that the additional time required to cover the cement when one or two sizes or coarse aggregate are used is practically the same as the time required to load from the second bin when three sizes of aggregate are used. Therefore, where all the materials are hauled in by truck the cost of the one item of batching, if handled as shown in Figure 1 will be nearly the same whether one, two or three sizes of coarse aggregate are used. The only increase in the batching plant itself is the employment of one additional bin operator and the use of an additional bin when three sizes of coarse aggregate are required.

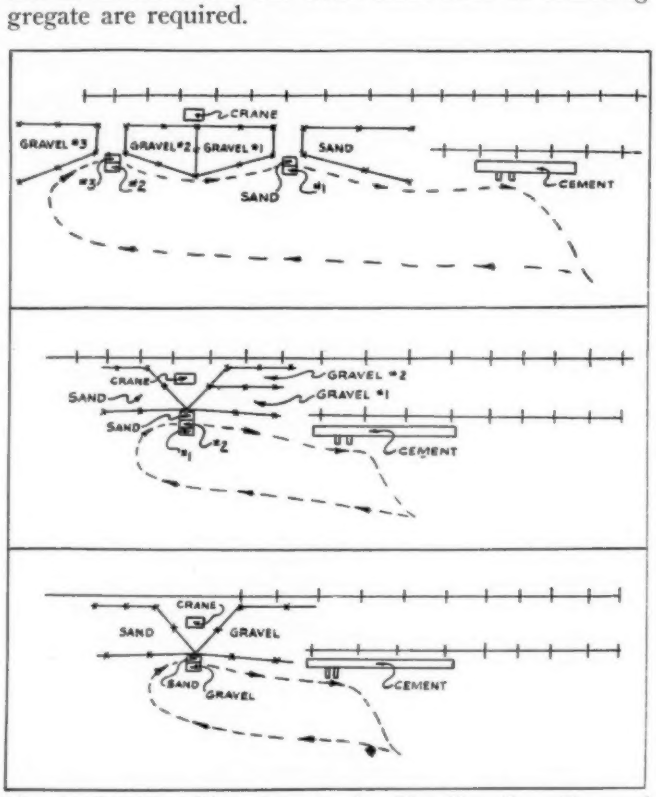

Fig. 2.—Batching Plant Layouts for Handling One, Two and Three Sizes of Coarse Aggregate When Aggregates are Hauled in by Railroad

Table II summarizes the average operating characteristics of 2-batch trucks when loaded from a batching plant of the type shown in Figure 2. The two sizes of coarse aggregate are handled with practically the same ease and speed as one size, the difference in loading being only 5 seconds. There is, however, a difference of 54.6 seconds between the batching plant truck time constants when handling one or three sizes of coarse aggregate. This longer time constant may readily require the constant use of one extra truck to absorb this time, which, if 2-batch trucks are used exclusively, may amount to practically $25 a day. Considering one extra

operator for the added bin and the cost of the extra bin, the added cost for the three sizes of coarse aggregate is about $35 a day.

One crane can load the bins for three sizes of coarse aggregate for a batching plant layout such as shown in Figure 1. However, if all the aggregate must be passed through the stock pile for the type of batching plant shown in Figure 2, then two cranes will be required. Therefore, the additional cost of handling three sizes of coarse aggregate with the plant layout shown in Figure 2 may be as much as $85 a day more than for the layout shown in Figure 1.

Furthermore, when three sizes of coarse aggregate are handled at a railroad siding, greater facilities for switching, which are sometimes extremely difficult to obtain, have to be provided as well as a larger plant site. To secure delivery of all sizes at the proper rate and in the proper order is even more difficult. The chances for delay are therefore considerably increased and this naturally tends to increase still further the cost of batching three sizes of coarse aggregate from a railroad siding layout. If, in addition, the bins are so placed that the trucks have to turn and back under each bin, then the truck time constant at the batching plant will be further increased from 30 to 40 seconds. It is these latter unknown hazards which weigh heavily against the use of three separate sizes of coarse aggregate when the batching must be done at an ordinary railroad siding.

From the standpoint of batcher operations there is but little objection to the use of two sizes of coarse aggregate if 3-compartment bins are available. The real difficulties come in finding room for three instead of two stockpiles and in getting cars spotted correctly, as well as having each shipment carry the proper amounts of each size and the proper gradation. These difficulties, however, are much less for two than for three sizes of coarse aggregate.

Care should be exercised to have the batching plant roadway well drained and maintained. The driveway under the bins should not be depressed especially if the soil is bad, because this may prove a prolific source of delay. Instead, the bins should be raised on concrete foundations to give head room for the trucks. This not only eliminates the necessity for depressing the roadway under the bins but also provides a safeguard against bin settlement. Any bin or set of bins should have capacity for at least one hour's run of the mixer. All bins should be arranged so that the trucks can drive straight through the bin or bins without turning or backing. The coarse aggregate sizes and the sand should be

TABLE I

Average batching plant characteristics for 2-batch trucks in plant layout shown in Figure 1.

	Seconds
Three sizes	
Load gravel Nos. 1 and 3	34.6
Load cement	54.0
Load sand and gravel No. 2	33.0
	121.6
Drive in yard	11.1
Drive from Hopper No. 1 to cement bin	7.6
Drive from cement bin to Hopper No. 2	6.8
	25.5
Fix batch board	39.2
	186.3
Two sizes	
Load gravel Nos. 1 and 2 and sand	45.0
Load cement	54.0
	99.0
Drive in yard	11.1
Drive from Hopper No. 1 to cement bin	7.6
	18.7
Fix batch board	39.2
Cover cement	25.0
	181.9
One size	
Load gravel and sand	40.0
Load cement	54.0
	94.0
Drive in yard	11.1
Drive from Hopper No. 1 to cement bin	7.6
	18.7
Fix batch board	39.2
Cover cement	25.0
	176.9

TABLE II

Average batching plant characteristics for 2-batch trucks operating in plant layout shown in Figure 2.

	Seconds
Three sizes	
Load gravel Nos. 1 and 3	34.6
Load sand and gravel No. 2	33.0
Load cement	54.0
Cover cement	25.0
	146.0
Drive in yard	60.0
Drive from Hopper No. 1 to Hopper 2	7.0
Drive from Hopper No. 2 to cement	14.0
	81.0
Fix batch board	39.2
	266.8
Two sizes	
Load gravel Nos. 1 and 2 and sand	45.0
Load cement	54.0
Cover cement	25.0
	124.0
Drive in yard	40.0
Drive from Hopper No. 1 to cement	14.0
	54.0
Fix batch board	39.2
	217.2
One size	
Load gravel and sand	40.0
Load cement	54.0
Cover cement	25.0
	119.0
Drive in yard	40.0
Drive from hopper to cement	14.0
	54.0
Fix batch board	39.2
	212.2

confined by planking to reduce the stock pile area as well as to keep the plant site area at a minimum for the efficient operation of the trucks and the crane. These sources of delay are mentioned only briefly, yet are of sufficient importance to warrant the exercise of great care in order to eliminate a source of possible delays to the mixer. A combination of delays such as may be caused by empty bins, truck speed reduction due to rough and poorly drained roadway within the plant, etc., may add an additional minute, on an average for a day or more, to the truck time constant, which if not absorbed by the addition of another truck will probably reduce the mixer production about 4 per cent.

The studies indicate rather clearly that the direct cost of handling two sizes of coarse aggregate need not be greater than the cost of handling one size of coarse aggregate, provided a 3-compartment bin is used, a well-planned layout is made, and good supervision is maintained. Where the materials are hauled in by truck or the batching plant is set up at a local producing plant, the cost of handling three sizes of coarse aggregate should not exceed the cost of handling one or two sizes by more than 2 or 3 cents per batch provided the layout suggested in Figure 1 is used and the operation is properly supervised.

When the bulk cement can not be loaded between the aggregates or when sack cement must be used or is required the cost of handling three sizes of coarse aggregates will be approximately $35 a day more than the cost of handling one or two sizes of coarse aggregate even when using a straight line loading plant layout.

When the aggregates are handled at the railroad siding and have to be stock piled first then this added cost will be increased to $85 a day, using the same straight line loading plant layout.

Finally, careful planning of the plant location and layout when supplemented by constant and able supervision, can insure a substantial saving in the cost of truck operation regardless of whether or not multiple sizes of coarse aggregate are required and can reduce the risk of mixer delays due to batching operations.

Dean A. N. Johnson Honored

Dean Arthur N. Johnson of the College of Engineering, University of Maryland, and a pioneer in highway engineering was presented the George S. Bartlett award which is given each year by road groups as a recognition of outstanding highway services. The award was bestowed at the banquet of the Highway and Building Congress in Detroit.

The award is a bronze plaque on which is carried a likeness of Mr. Bartlett who has also devoted his life to the furtherance of good highways. It is awarded jointly by the Highway Research Board, the American Association of State Highway Officials and the American Road Builders' Association. Last year the award was presented to Thomas H. MacDonald, Chief of the Bureau of Public Roads.

A. N. Johnson

Dean Johnson is the only surviving member of the first class in highway engineering to be conducted in the United States. This class was started in 1893 at Harvard from which Dean Johnson graduated in 1894. Shortly after becoming state highway engineer of Maryland in 1898, Dean Johnson mapped out a highway system which is substantially the main state highway system of today.

Following his seven years as state highway engineer of Maryland he became highway engineer of what was then called the U. S. Office of Public Roads. Dean Johnson served as state highway engineer of Illinois for twelve years, and later became consulting highway engineer for the Portland Cement Association. In 1920 he was appointed dean of the College of Engineering of the University of Maryland, a position he still holds.

Dean Johnson's career started concurrently with the growth of the Automobile, so during his lifetime of service he has been responsible for much advancement in highway engineering. Notable achievements were made by Dean Johnson in his studies of the elastic behavior of concrete pavement and his highway traffic studies.

Industrial Research Laboratories

The Research Information Service of the National Research Council is preparing a revision of its "Industrial Research Laboratories of the United States, including Consulting Research Laboratories," the fourth edition of which was published in 1931 and contained over 1,600 such laboratories.

This bulletin is the only list of industrial research laboratories known to the compilers (Clarence J. West and Callie Hull) and is undoubtedly used by many persons, not only as a source of information concerning such laboratories but also as a mailing list for important announcements concerning new apparatus and processes and for compilations of interest to research workers in industrial fields.

In addition to the 1,600 laboratories already known, it is very desirable that additional laboratories be listed, if such are in existence. While every effort will be made to locate such firms, it is felt that many will be overlooked unless they are called to the attention of the compilers.

If the reader of this note is a member of a firm maintaining a research laboratory and if it is not known whether the firm in question is already listed in the previous bulletin, it is hoped that a request will be forwarded immediately to the Research Information Service, National Research Council, Washington, D. C., requesting a questionnaire, in order that the forthcoming bulletin may be made as complete as possible. The listing involves no financial obligations on the part of any firm and may be of considerable value, since this publication is recognized by all familiar with it as a valuable source of information regarding industrial research activities in the United States.

The data included in the bulletin are made up of the name and address of the firms, the research directors and the research problems engaging the attention of the laboratories. There are also included an alphabetical list of research directors, a subject index of research interests and a geographical index of firms.

In order to avoid inquiries regarding the appearance of the bulletin, it may be stated that the bulletin will not be available for distribution before September, 1933.

Safety Gaining Place

"Safety comes ahead of schedules. Safety comes ahead of personal rights. Safety comes ahead of everything else."

There is a lesson in this for every driver. If it's a question of speed or safety, choose safety.—Arizona Highways.

What Highways Mean in Economic, Educational and Social Life of United States

By THOS. H. MACDONALD
Chief, U. S. Bureau of Public Roads, Washington, D. C.

THE dominant motive behind the conception of this Highway and Building Congress is group co-operation. The circumstances resulting from grave causes, national and international, which are resisting and devitalizing our efforts to better economic conditions, have crystallized this undertaking for mutual helpfulness and for the supporting strength that lies in organized effort.

This Congress in itself presents two aspects that mark tremendous strides forward in human relationships which have taken place in a relatively short period of world history, a cohesion that is the outgrowth of adversity and a generous sharing for the common good.

The wholly voluntary character of the desire and the decision to participate in the Congress by so many organizations is both a credit to those responsible for the policies and an assurance that the construction industry as a whole is thus best served. It is a forerunner of better times that the spirit of common effort to advance the common good so greatly distinguishes this first inclusive construction congress.

For three years now we have been attempting to achieve economic recovery largely on the basis of destructive criticism of every effort involving expenditures. Particularly has widespread criticism revolved about government and taxation from which government expenditures are financed. This is no objection to constructive criticism. Let every item of expenditure that cannot stand on its own merits be eliminated. This is not an inference that taxation is not unequally and unwisely distributed among sources. It is a protest against the "half truths that are worse than falsehoods" and the magnification of minor and incidental matters which have a wholly inconsequential effect upon either the level of governmental efficiency or the amount of governmental expenditures.

It is because of the spirit behind this meeting, a common effort for the common good, that I have felt it an opportune time to stress the principle that sound government, functioning through laws and their administration, is the most important single element to the many sections of the construction industry dependent upon the highway improvement program of the future. This same principle holds true, directly and indirectly, for perhaps all of the construction field; but it has a wholly controlling effect upon future highway expenditures.

It is taking no great liberty with the subject assigned to compress it simply to highway values, and in place of attempting a complete inventory of these many and varied values, to develop some of the more important phases of a situation which now confronts not only the highway construction industry in all its various ramifications, but also the users of the highways, the general public.

Highways and Highway Transport a Going Concern.—The most significant fact is that highways and highway transport are a going concern. What other major activity has held so closely to prosperity levels judged by the statistical record?

Motor vehicle registration reached the high figure in 1930, with 26,545,281 vehicles licensed. During that year these cars consumed an average of 554 gal. of tax-paid motor fuel, with an average tax rate of 3.35 ct. per gallon.

In 1931, motor registration decreased by 731,178 vehiles or 2.8 per cent less than for 1930, while there was an actual increase in fuel consumption of over 656,000,000 gal. or 4.4 per cent. Consumption per car reached 596 gal. with the average tax increased to 3.48 ct.

These figures deal with the United States as a unit and show on the whole a more intensive use of highway facilities. Even though the number of users has decreased, further investigation shows that highway transport has become so important a part of our business life that the effects of the depression have not been able generally to restrict motor vehicle use, and that only in those states and localities where the depression has most seriously affected the value of the staple commodities has an actual decrease of gasoline consumption been recorded.

The income from special taxes for the use of streets and highways paid through registration fees, license fees and gas taxes, has grown from $121,469,000 in 1921 to $829,381,000 in 1931. The utilization of the more than 25,000,000 motor vehicles provided transportation totals running into inconceivable and fantastic amounts, but nevertheless reasonably correct. These may be approximately expressed as follows:

150,000,000,000 vehicle-miles of private passenger car transportation.
24,000,000,000 ton-miles of local haulage, transportation and delivery of produce.
11,000,000,000 passenger-miles of bus transportation.

These 25,000,000 vehicles consume annully about—

15,400,000,000 gal. of gasoline.
450,000,000 gal. of lubricating oil.
50,000,000 tire casings and tubes.
$400,000,000 worth of parts and accessories.

They furnish direct employment to—

200,000 persons in their manufacture.
150,000 persons in the manufacture of tires, parts and accessories.
750,000 persons in garages, filling and service stations, etc.
2,500,000 persons as truck, taxi and bus drivers and private chauffeurs.

They furnish sources of direct revenue to railroads amounting to great sums annually from—

Highway and street materials.
Materials and supplies shipped to motor vehicle factories.
Finished cars shipped to dealers.
Freight on gasoline, oil, tires, parts and accessories.

Public roads form the only avenue for the movement of the produce from 6,000,000 farms, with a total normal annual production value of about $12,000,000,000. Much of the movement of these products is now by motor. Thus, in 1931, over 21,000,000 head of livestock were

brought to market by truck. Practically all of the rural mail is carried by motor vehicles.

Highways and Rural Education.—Included in the vast movement of vehicles over our public roads and streets are about 55,000 school busses.

In the school year 1919-1920, 350,000 pupils were transported to rural schools. For year 1929-1930 the number had increased to 1,903,000.

Even with the great advance that has been made in road improvement during the same period, a survey made recently by the U. S. Office of Education of rural school problems found that the query "What is your greatest transportation difficulty?" was answered by 33 per cent of the superintendents of rural schools as "Poor roads."

A survey made by the American Farm Bureau Federation reports that of 5,820 rural schools in 71 counties, 1,758 were located on surfaced highways and 4,062 on unsurfaced highways.

Highways and New Farm Business.—Although the trucking of farm produce to city markets is not as yet so organized as to be free from many disadvantages, two facts stand out as important: (1) That the consuming markets are drawing larger amounts of the fresh and highly perishable fruits and vegetables from nearby producing areas, thus obtaining a better quality, and (2) "To some extent, the motor truck movement in several localities represents an actual gain in consumption—something that the farming population sorely needs to see if its production per man is to continue to increase as it has during the recent past."*

There is no way to calculate the increased consumption of the citrus fruits or other perishable foods which transportation in bulk by motor truck has promoted. Large quantities of the lower grade fruits that in past years have rotted under the trees have been disposed of at prices that have provided the grower with some income.

Highways and Tourist Traffic.—While our economic thought turns upon the tangible products and the returns from commerce in goods, improved highways and the motor vehicles have generated new sources of income such as the tourist business.

The tourist traffic in Michigan from other states, based upon the results of the Michigan transport survey, 1930-1931, was as follows: 2,500,000 cars entered the state, the average number of persons per car was 2.8, and the average stay in the state 11 days. An expenditure at the rate of $3.50 per day per person would be approximately $270,000,000, which is 2½ times the total expenditure for rural roads and city streets in the state for that year. In our West it is an accepted fact that catering to the tourists is one of the big businesses of the whole area. Something of its extent is indicated by the transport survey on the Federal aid highway systems of the eleven western states in 1930, for which the out-of-state traffic ranged from 4.9 per cent of the total traffic in California to 38.5 per cent in Arizona. In those which have large areas of publicly owned lands, sparse population, the difficulties of arid climate and rugged mountains, the ratio of tourist traffic to the total traffic reaches an average of approximately 16 per cent, or an average of more than 3,000,000 vehicle-miles daily.

The number of visitors to the National Parks has shown a remarkable growth. For the fiscal year 1932, 2,948,507 persons entered the parks in 811,000 motor vehicles.

Highways and Decentralization of Industry.—The tentative report of the Committee on Industrial Decentralization and Housing of the President's Conference on Home Building and Home Ownership states: "The natural trend toward a better standard of living and the forward movement of human wants works with a freer hand and under a greater stimulus in the development of the home and the pride of home ownership than through any other channel. Industry, therefore, must be very definitely interested in better homes, in home ownership, in the economic self-reliance of the individual, etc." * * *

"Owing to this fact that the existence of industry is dependent upon human needs and that the further growth of industry depends upon the further development of human wants, the consequent natural premise must be that industry, for its own good, should undertake a serious study of living conditions and endeavor to devise all possible means, through its location or relocation, to permit those who depend upon it for employment to avail themselves of the things that make for better health and for such better living conditions, that will make possible the continued growth and development of human wants and lend assistance to the satisfaction of those wants which, in turn, depend upon the preservation and further stimulation of the morale and the economic self-reliance of the individual."

In its tentative conclusions "The committee wishes to emphasize the influence the transportation system has exercised toward concentration and, particularly, to call attention to the effect the railroad rate-structure has had. * * *

"The historical development of the railroad rate-structure has been one which has strongly tended to force industry to locate in large centers."

The studies of the impact of taxation which have been carried on for several years by the University of Wisconsin and the Bureau of Public Roads, have pointed in a startling way to the rates of taxation which have become characteristic of the largest cities. The per capita taxation in two states, inclusive of all except Federal taxes, is:

PER CAPITA TAXES

Unit	Highways and Streets	Education Public Services Government	Total
WISCONSIN—1930			
Rural	$21.13	$35.86	$56.99
Municipalities			
Places to 2,500	16.30	43.87	60.17
2,501 to 15,000	15.53	52.79	68.32
15,001 to 75,000	17.43	65.22	82.65
Milwauke	15.62	81.90	97.52
Total (State)	18.10	53.92	72.02
ILLINOIS—1931			
Rural	$12.65	$40.57	$53.22
Municipalities			
Places to 2,500	23.12	35.25	58.37
2,501 to 15,000	22.62	46.43	69.05
15,001 to 75,000	19.77	46.15	65.92
75,001 to 400,000	19.40	43.84	63.24
Chicago	21.00	74.21	95.21
Total (State)	19.69	56.63	76.32

There is not a common base for comparison between the states but the figures are comparable between the communities within each state. The large difference between the per capita tax in the large cities and that of the rural districts and smaller municipalities is one of the items, amongst many others, which make higher living costs in our largest population centers. It is questionable if these largest cities offer advantages consistent with the much higher living costs, and the evidence points to the economic desirability of decentralization of population at least insofar as the largest centers are concerned.

Unquestionably high transport will be one of the chief factors in providing industry with a greater freedom as

*Farm to City by Motor Truck, by C. B. Sherman, U. S. Department of Agriculture, American Bankers' Association Journal.

to location. It has also added to the possibilities of the development of a desirable social life in the smaller communities and this has removed a decided objection to living in such communities on the part of those accustomed to the larger cities.

Perhaps the most notable changes that have been the outgrowth of dependable highways and the motor vehicle, are the increased social and educational advantages that have been made easily available to those of the rural communities and smaller municipalities. The spread between the cities and the smaller communities, as measured by such advantages, has been greatly lessened, and the natural advantages of easily accessible rural areas and the attractive natural surroundings of these smaller communities have been likewise increased. Of all the great advantages that have come through improved highways and the motor vehicle, the greatest undoubtedly consists in the opportunity that is now possible for the average family to establish homes in pleasanter and more natural surroundings than the big cities can offer. If in this country we are to maintain our boasted standards of living for the average citizen, every encouragement and assistance to attain such a worth while objective ought to be offered.

Highways and Unemployment.—One of the statements that has received widespread circulation is that our productive capacity is now such that even though business were resumed on a normal scale it would be impossible to draw back into industry more than a reasonable percentage of those now unemployed. There is no great reason to doubt this statement, but it is doubtful if the real reasons are generally understood.

During the 10-year period that followed the war, from 1919 to 1929, generally regarded as the peak of our industrial production, a tremendous volume of labor was engaged in general construction activities. These activities covered a wide range of expansion in private fields, such as the erection of manufacturing plants, the rehabilitation of the railroads, the building construction of business and service plants connected with the motor vehicle, the growth in the output and the opening of new oil fields, requiring the building of pipe lines, the development of electrical power plants and their distribution facilities. All of these demanded labor, and it is probable that the entire construction program, including new equipment and public construction, reached a peak in 1929 of fifteen billion dollars or more. It is probable that this tremendous construction program absorbed upwards of one-fourth of the entire working population. A very large amount of this labor was used for permanent improvements and for increasing our productive facilities and was not used for actual production within these plants. Such a diversion of labor to the construction field would not under other circumstances have been possible, but running in parallel with the diversion of workers to the construction field were the increased mechanical efficiency and use of power which permitted labor to be diverted from production to construction.

This immense construction program caught up with the lag and for a time ran on its own momentum beyond the demand, which explains in a large degree the tremendous drop in speculative values, in the loss of paper profits and a tremendous shrinkage in the capital investment.

If we should consider around nine billion dollars a normal construction program, it is apparent that the 1929 construction program was increased by at least 66 per cent, and if our total construction program is, at this time, around five billion dollars, there is today not more than one-third of the expenditure in this field that existed in 1929. A very large part of the present unemployment and lack of purchasing power has been caused by the tremendous decrease in construction.

Highway construction is the one activity that so far has held up to about the previous level, and through the efforts to extend employment the number of men engaged in this work, directly and indirectly, has been increased in proportion to outlay. While highway work is to a considerable extent seasonal, through 1930 the state and Federal aid work provided a continuous average direct employment of 288,000 men, which together with those engaged in the production of materials and equipment and transportation totaled close to 1,000,000 persons.

In the first part of 1932 employment dropped off due to depletion of funds until the Federal emergency appropriation of July, 1932, and for the fall months of 1932 the total employment on state and Federal work has been brought back to nearly 400,000 workmen. Due to the limitations on hours now generally enforced, the ratio of those indirectly employed is possibly less than for the previous years, but at least upwards of 800,000 men are directly and indirectly dependent upon the income from the Federal and state highway construction and maintenance activities.

Due to the decreased demand for materials by other branches of the construction industry, the most careful estimates possible indicate that highway construction is taking now about half of all the cement that is being produced. The last figures available for production of aggregates are for 1931. For that year highway work took about 69 per cent of the crushed stone, 43 per cent of the sand, and 64 per cent of the gravel produced. The figures for the past year's current business are not available, but due to the further decrease in general construction it is estimated that 70 to 75 per cent of the crushed stone, gravel and sand production is going to road and street construction and maintenance activities.

Of the 1929 volume of asphalt and asphaltic oils consumed, around half was used for streets and highways, this half represented at least 60 per cent of the value. The percentage of value used for current business is undoubtedly higher. Likewise considerable quantities of steel, lumber and fuel for the production of power are being consumed in the highway field.

In the equipment field in August, 1931, reports on more than 5,000 activitive projects on the state highway system indicate that there were in use at that time: 2,150 power shovels, 1,175 cranes, 700 pavers, 1,750 mixers, 1,775 rollers, 24,500 trucks and 5,450 tractors. The repairs, replacements and additions to this equipment produce a very large percentage of the present equipment business.

The use of rail transportation in connection with highway construction and maintenance involves the handling of gravel and sand, stone, asphalt, fuel, road oils, machinery, cement, automotive equipment, explosives, steel and other materials.

The rail transportation is used not only in moving a large part of this tonnage to the road work, but it is used in assembling the materials at points of production. For example, the manufacture of steel involves the transportation of ore, coal, and flux from their points of origin to the steel plants.

From a study of the records of the Interstate Commerce Commission showing total tonnage of the various materials handled by the railroads in 1931, it is probable that upwards of 15 per cent of the total tonnage moved by rail during 1931 originated in the activities required to meet street and highway improvement demands.

In reports compiled from over 5,000 active highway projects, there were engaged in August, 1931, 14,500 teams, 24,500 trucks and 5,450 tractors. Road and street construction required plants depending on the type varying from the simplest equipment for small grading jobs of possibly $2,000 up to around $50,000 for paving equipment.

The estimated value of the equipment employed on 5,000 projects to which reference is here made indicates that tools and equipment aggregating a value of about $160,000,000 were in use. Replacement and repairs of such equipment on a basis of three to five years would indicate an annual equipment expenditure of around $40,000,000 to $50,000,000.

No pretension is made that this analysis covers or indicates either the tremendous dimensions or the nation-wide spread of the highway improvement business as it relates to providing for employment or as it generates demand for manufactured products and rail transportation. The highway construction and maintenance industry is so large and so distributed that it is possible only to indicate in this review something of its significance to the economic life of the nation at the time when we are at the low ebb.

One thing is certain. With all materials, as well as the prices bid for work, reduced beyond all reasonable chance for profits, 80 to 90 per cent of the dollar spent for road work is paid out for labor and personnel employment. With the reduced hours and the policy of employing through local committees those most in need, the distribution of the road expenditures is generally reaching those for whom provision is most necessary.

As a very pertinent observation, the spirit that has actuated the whole construction industry to give as much employment as possible and to carry on regardless of profits, cannot be too highly praised. All who are connected with this industry have shown a public spirit that is unsurpassed. In times of such intense stress the small number of complaints reaching the Bureau of unfair attitude or practices is remarkable.

Improved Highways an Accomplishment of Government.—The improved highways of the nation which have made possible the far-reaching and widely diversified utilization of the motor vehicle have been accomplished through government. They are the result of public policies and public administration.

The evidence here presented, which is far from inclusive, can be interpreted in only one way—that highway transport is performing services so intimately and so necessarily a part of every phase of individual and community life that the use of existing and the extension of new highway facilities have been adversely affected by a relatively small percentage up to this time.

The future is more uncertain. There are many forces working not only to stop new work but to undermine and destroy much of the value existing in that which has been accomplished.

While the major construction program has been carried out over the past ten years, these tangible results had their beginnings at least 40 years ago when the first states began to plan their highway systems on the basis of business management and engineering principles. Such results as have been obtained through public administration of the improvement of highways in the past ten years have not become reality through magic or sudden inspiration. It required upwards of 30 years to develop the principles and policies which are responsible for today's improved highways. But it will be possible to tear down and to destroy much of this achievement in good government almost over night unless calm judgment rules.

State Highway Commission the Key to Good Administration.—The beginning of highway administration consistent with modern needs was the establishment of the first state highway department. The next step was the establishment of a state highway system, segregating those roads of most importance for state jurisdiction. Little by little these principles were extended until the Federal Highway Act of 1916 required that all states, to participate in the Federal funds, must establish a state highway department, and this was followed by the requirement in 1921 that there must be selected a Federal aid system not exceeding 7 per cent of the road mileage on which funds were to be concentrated until the system was adequately improved. The state highway systems have been extended now to 330,000 miles, but they have in general been determined by traffic requirements.

These departments have generally been developed to a high degree of technical skill. Through cooperation within the American Association of State Highway Officials and with the Bureau of Public Roads the results of research and experience have been written into standard specifications and methods of business procedure designed to secure the best and most economical results.

Generally the construction work has been carried out through the letting of contracts on a strictly merit basis and this has helped to built a strong, efficient body of contractors. Through the use of constantly improved methods and equipment the rate of production has been increased and the standards of workmanship and finished product have been constantly improved.

Lying back of much of the value which we are obtaining from large mileages of highways improved with low cost surfaces, are the highly organized maintenance operations of the state highway departments which are holding our roads against depreciation even though traffic has tremendously increased.

What Must Be Preserved.—In the months that lie ahead whatever is done to promote economy or to secure relief from property taxation insofar as it affects highway funds must commence with the state highway departments as the key to any sound accomplishment. It is possible to extend the authority and responsibility of these departments over large mileages and still obtain economical results. It is not possible to decrease or hamper them without disaster. A very large percentage of our highway mileage that is carrying heavy traffic is of relatively light construction. To decrease the ability of the highway departments to function or to lessen the funds required for adequate maintenance will result not only in a loss of adequate service but a rapid depreciation of the capital investment.

It has been the uniform practice for the past decade to predicate the bonds which have been issued for state road improvement upon the income from the special road user taxes. The interest and debt retirement commitments against these funds are sufficiently large in a number of the states, together with necessary maintenance, to make it impossible to divert any of the income from the control of the departments and still preserve the credit of the state and the capital investment in highways.

While conditions vary between the states as to the fixed commitments against the special road taxes, economy cannot be obtained by diverting these funds to other than road purposes. In states which have an income that is more than adequate to meet fixed and necessary charges, it is possible to secure some relief from property taxation by the extension of the control of the state

highway department over additional mileages of roads which are now wholly dependent upon property taxes.

As a concluding remark, highway construction and maintenance offer a field in which production does not pile up surpluses, provides for consumption of materials, for the profitable employment of labor, and leaves behind a utility which yet fails to meet the public demand in every section of the country. As an example of the efficient organizations of the state highway departments and the highway contracting industry of this country, since the Federal emergency construction highway fund was made available at the end of July, there has been placed under construction 7,020 miles of new highways or more than sufficient to reach two times across the continent from the Atlantic to the Pacific. In addition 3,000 miles are ready to go under construction when weather permits, or a total of 10,000 miles, which will involve a total cost of around $156,000,000. The number of people in this time of depression who will receive a livelihood from this source alone will reach into several millions, and the amount involved is less than 20 per cent of one year's income which we are collecting througl the special taxes upon the road user.

Economic recovery can not be helped by a breakdown in our sound highway administration policies.

Acknowledgment.—The foregoing is a paper presented Jan. 19 at the Highway and Building Congress, Detroit, Mich.

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Diversion of Motor Funds Widespread

Serious impairment, if not actual stagnation, faces the great highway system of the United States in consequence of the widespread diversion of motor funds to other than good roads purposes, according to J. Borton Weeks, president of the American Motorists' Association.

"The sinister aspects of diversion are fast becoming apparent," said Mr. Weeks, in a statement, "and there are country-wide indications of a motorist revolt against continued use of motor funds for any purpose except highway extension, improvement and maintenance. This revolt cannot come too soon if the highway program is to be saved.

"Diversion not only seriously interferes with the upkeep of present highways, but postpones far into the future the ultimate completion of the country's road system.

"In utter disregard of the country's need for more highways, various states last year diverted to other purposes more than $120,000,000 contributed by motorists specifically for roads. Motor fund raiders probably will divert even more this year unless motorists make a determined stand against it.

"Effects of diversion are already apparent in badly maintained roads in some states. Such highways become a liability instead of an asset. The economic loss through damage to motor vehicles and injury to their occupants is enormous.

"Another danger to the highway system is the impairment of credit which will result if there are any defaults on interest or principal on the many millions of highway bonds now outstanding. These bond payments, in most cases, are to be made from gasoline tax and license funds which are being diverted to other uses. Obviously, any such impairment of credit would seriously embarrass road building programs of the future."

Arguments Against Diversion of Highway Funds*

Many splendid thoughts on this subject have come to our attention and we deem it expedient to submit several of them for your consideration as follows:

1. The tax is equitable for road building purposes because it is assessed against those who use the roads in proportion to such use, but it is inequitable for general or other special purposes.

2. Diversion even for worthy uses encourages the habit with lawmakers and opens the door to grabs for an endless variety of purposes.

3. Diversion of these funds breaks faith with the road users, repudiating the pledges of the lawmakers that they would be used exclusively for road building.

4. The legality of diverting motor vehicle revenues is in question. Court attacks would be invited stopping collection of the tax and tying up funds already collected.

5. Diversion of road funds would take away needed revenues which would have to be secured through other sources.

6. Modern highway requirements demand a dependable fixed income for roads. This is provided by the motor vehicle taxes. Diversion would cause confusion, waste and delay.

7. Motor vehicle funds provide employment; diversion adds to unemployment. From 75 per cent to 90 per cent of the road dollar is eventually paid out for wages and salaries. Road and street building required the labor of 3,000,000 in 1931.

8. Road construction has a direct effect on the prosperity of the automobile industry, which provides employment of 4,000,000 men and uses the products of 1,000,000 additional men. By lessening road building, diversion would decrease the demand for motor vehicles and products.

9. Divert the motor vehicle revenues and road building costs or deficits may revert back to general taxes.

10. Diversion of motor vehicle funds would make the tax so unpopular that its usefulness would be destroyed. Then neither road building for the purposes for which the funds were diverted can benefit.

11. By interrupting highway construction and maintenance, diversion of motor vehicle funds would deny road users the benefits of decreased operating costs to which they were entitled as payers of the tax.

12. If the public permits, diversion of motor vehicle funds may be attempted in preference to making much needed economies in governmental administration.

13. Diversion of motor vehicle funds away from highways and streets would further hamper highway industries and contracting which are large employers of labor, have extensive investments in plants and equipment and are large contributors of general taxes—and we repeat—

14. It will hurt employment in thousands of factories and also in the many machinery distributing organizations.

*From a sales bulletin of the Iowa Manufacturing Co.

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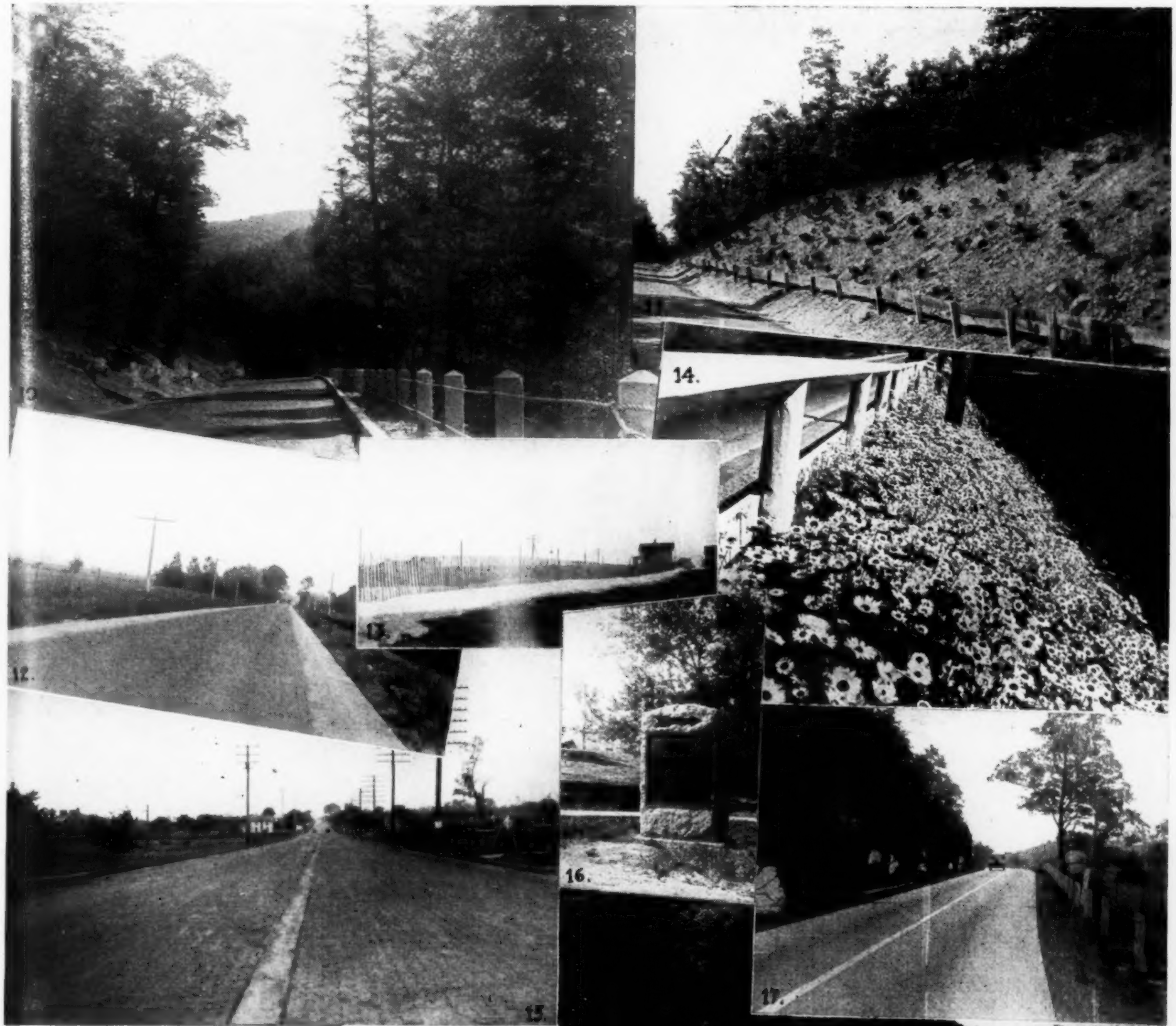
TAKING OVER COUNTY ROADS.—An increase of approximately 50 per cent in the mileage of the Minnesota trunk highway system would result if bills introduced in the legislature thus far creating new trunk routes were passed, it is shown by a tabulation by the state highway department.

MISCELLANEOUS DETAILS

1. ROAD SIGN. ALSO CENTER LINE PAINTED WITH ASPHALT EMULSION.
2. ROADSIDE BEAUTIFICATION. CALIFORNIA.
3. POOR SUB DRAINAGE CAUSING FILL SLIDE. WASHINGTON.
4. GUARD RAIL, SUPERELEVATION, AND CURVE WIDENING. ARKANSAS.
5. WIDENED IN 1927. CENTER LINE NECESSARY. DELAWARE.
6. AIRPLANE VIEW OF GOOD LOCATION. CALIFORNIA.
7. BAD CURVE AND BRIDGE IN OLD ROAD, RIGHT, ELIMINATED BY RELOCATION AND NEW BRIDGE, LEFT.
8. ROAD FROM RIO DE JANEIRO TO PETROPOLIS. EARTH GUARD RAIL.
9. CURVE WIDENING WITH BITUMINOUS MIXTURE.

HERE AND THERE

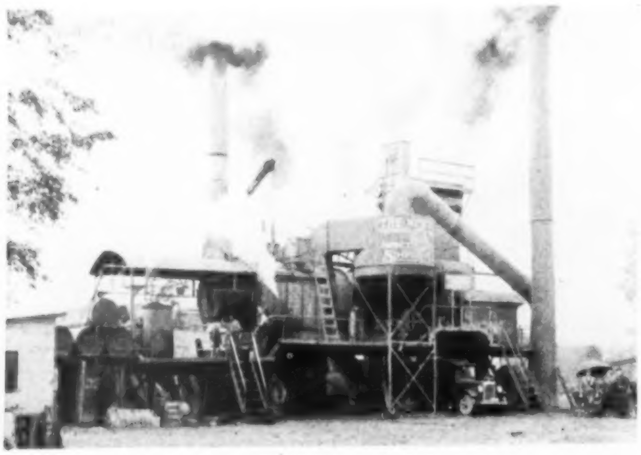


10. HUB RAIL AND GUARD RAIL PROTECTION. MASSACHUSETTS.
11. PLANTING TO HOLD EMBANKMENT MASSACHUSETTS.
12. BRICK RESURFACING, THREE FOOT WIDENING. OHIO.
13. SNOW FENCE.
14. FILL SLOPE TREATMENT IN MASSACHUSETTS.
15. LINCOLN HIGHWAY WEST OF MASSILLON, OHIO. CENTER LINE POURED OUT OF CONCRETE.
16. MARKERS. NEW HAMPSHIRE.
17. PAINTED ROCK, CENTER LINE MARKER, AND GUARD RAIL. PENNSYLVANIA.
18. SUPERELEVATION, EARTH GUARD RAIL, BRICK PAVING. TENNESSEE.

24¾-Mile Black Top Job Completed in Quick Time

THE longest resurfacing job let in Ohio in one unit was completed in record time by The Wesco Co. of Chattanooga, Tenn., M. Russ, General Superintendent. This resurfacing was constructed on U. S. Road 30-S, the Lincoln Highway, East from Lima, O. The work consisted of installing 2 ft. of concrete widening on each side, the outer 9 in. of which carried a header to act as a curb, between which was built an asphaltic concrete surface 18 ft. 6 in. wide, constructed to the T-5 Ohio hot plant mix specification, the road being 20 ft. overall in width.

The construction necessitated the laying of a wedge course to correct the old crown which was excessive, then a base or binder course approximately 1½ in. thick and a 1 in. top course. The job was 24¾ miles in length requiring approximately 40,000 tons of material and was built from a single plant set-up in Lima, with a maximum haul of approximately 26 miles, the material being handled in 5 to 60-ton capacity trucks.



Bituminous Concrete Mixing Plant Which Prepared Mixture

The work of laying black top was started Aug. 25th and was completed Dec. 1st, the operation being carried on in two 8-hour shifts working six days a week, except toward the end of the job when cold weather set in, when a 7-day week was used. Due to bad weather conditions, rain and snow, four to six weeks of working time was lost, there being prior to the middle of November, a 9 in. fall of snow which materially delayed the work which, according to original planning, would have been completed prior to Nov. 1st.

Hot-Mix, High Type Pavement Finished by Machine

A West Simplicity asphalt plant was used with a 2250 lb. mixing box.

A Lakewood finishing machine with special inside flanged wheels riding the concrete headers, and a new device known as a "compression strip dolly" which eliminates the necessity of carrying forward compression strips, was used throughout the work and spread not only the top and base course, but the wedge course as well. It was equipped with special high speed gears giving a forward speed of 14 ft. per minute, specifications allowing for 14 ft. per minute on wedge course and base course and 10 ft. per minute on top.

In conjunction with the finishing machine, there were two spreader boxes for rough spreading the material and into which the trucks dumped. The labor gang consisted of four men in front of the finishers operating the spreader boxes and assisting in spreading, one finisher operator, two back rakers and three 10-ton rollers.

Rollers Compacted Surface Until Cool

On first 8½ miles of work which had been checked and accepted by the engineer, there were but seven bumps in excess of ¼ in. in 10 ft. Since cold weather set in, it is anticipated that there would be an increase in such inequalities, but due only to the extreme bad weather conditions.

The T-5 specification is the new type of non-skid hot mix surface first tried out by Ohio in 1931 and is proving very satisfactory.

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Highway Expenditures Cut in Half

The Minnesota State Highway Department will spend less than half as much money in 1933 as in 1932, and will reduce the net amount spent for new construction by 75 to 80 per cent, N. W. Elsberg, Highway Commissioner, recently announced.

"Should there a 50 per cent cut in all license fees, even on expensive cars owned by the wealthy, it will be difficult for the Highway Department to meet its fixed expenses, such as interest and principal on outstanding bonds, and maintenance of the present trunk highways to prevent deterioration.

"The only important sources of 1933 revenue for the Highway Department are automobile license fees and the gasoline tax. If no change is made in present license rates, income from this source will be about $9,600,000. Income from the gasoline tax available to the Highway Department is estimated at $5,700,000. There will be about $200,000 of miscellaneous income. This makes a total for 1033 of $15,500,000.

Design and Construction of Small Span Suspension Bridges

By F. H. Frankland

Director of Engineering Service, American Institute of Steel Construction, Inc., New York City

THE following brief discussion of the basic theory of suspension bridge design is offered so that approximate designs may readily be prepared for the purpose of economic comparison with other types of bridges for any particular crossing. Owing to the rarity of occasions that the average bridge engineer engaged in the design of highway bridges has for becoming familiar with the comparative economics of suspension bridges, there are undoubtedly many crossings bridged by trusses, arches and viaducts that could more economically be crossed by bridges of the suspension type.

For locations where piers or trestle bents are difficult and expensive of construction or where suitable rock is not found at convenient locations to receive the horizontal thrust from arch spans, or where it may be desirable to use one instead of several spans—with no great increase in cost—it will be found that a suspension span solution of the problem is frequently surprisingly economic for crossings of 200 ft. or more in length.

Transportation and erection difficulties are invariably less for suspension bridges than for any other type of permanent structure, consequently the suspension type particularly recommends itself for those locations where these considerations are important.

Not only has the science of suspension bridge design been greatly advanced during the last few years but ideas of bridge architecture and aesthetics have been developed, whereas, in this country but a short time ago the small steel bridge was designed with an almost entire disregard to good looks. It is possible to make a small suspension bridge graceful, artistic, substantial and altogether as pleasing in appearance as an arch bridge, and frequently more so, as there are not as many drawbacks in developing a satisfactory appearance as there are with any other type of bridge.

The following design considerations will be dealt with: general theory, effects of live loads, stiffening trusses, lateral wind bracing, cables, towers, economic ratios of side spans to main span, economic ratios of cable deflection to span length, piers, and anchorages.

It is desirable that, in the design of small suspension bridges, the Elastic Theory be used instead of the Deflection Theory; the reason being that, in the Elastic Theory the curve of the cable is assumed to remain undistorted after the application of load, but in the Deflection Theory deformations due to load are taken into consideration. For small spans the deformations are small and no material error will result from the use of the Elastic Theory of design.

The Effect of Live Loads.—The effect of live load is to disturb the condition of elastic equilibrium that exists. The elastic stiffness of the stiffening trusses and the work required to distort the equilibrium polygon resist the deformation due to live load. The stiffness of the truss is proportional to its moment of inertia and the rigidity of the equilibrium polygon is a function of the external forces that reach the cable from the hangers. In other words, the greater the ratio of dead to live load the less are the stresses in the stiffening truss.

The deflection curve of a flexible chain or cable, of uniform section and material so that the weight of any part is proportional to its length, suspended from two points and having only its own weight to support, is a catenary. If, however, a series of loads of equal intensity are suspended from the cable at equal horizontal intervals the deflection curve closely approximates a parabola.

In preliminary design studies for small suspension bridges it is usually first assumed that the suspended dead and live load is uniformly distributed and the proportion of load carried by each hanger is the unit load multiplied by the length of the panel; that the curve assumed by the cable is a parabola under all conditions of loading and that the stretch of the cable is relatively small.

From Fig. 1 we see that

- l = span from tower to tower
- d = deflection of cable below points of support on the towers
- x and y = coordinates of any point with respect to the center or maximum ordinate of cable deflection
- H = constant horizontal component of tension in any portion of the cable
- w = unit dead load
- w' = unit live load
- W = total distributed dead and live load
- T = tension tangent to cable curve at R
- t = tension at any point P

Then $H = \frac{Wl}{8d}$, the constant horizontal component of tension in the cable. All external forces acting on the cable are vertical and have no horizontal component and the curve of the cable is $y = \frac{d \times x^2}{\left(\frac{l}{2}\right)^2}$ and dividing this by the allowable unit stress gives the required sec-

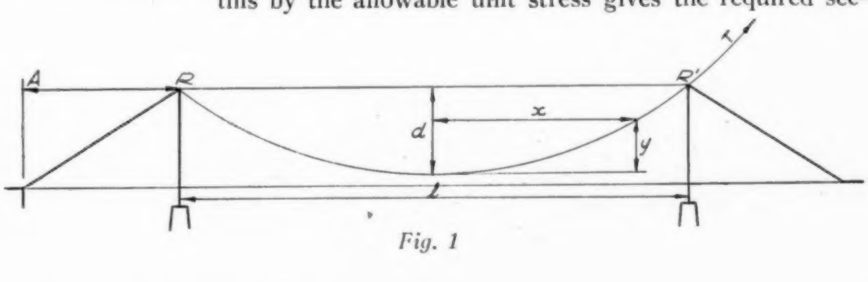


Fig. 1

tion of cable. The length of the cable between R and R′ is

$$2\sqrt{\left(\frac{l}{2}\right)^2+\frac{4}{3}d^2}$$

The tension in the cable increases from C to R and R′ where it is maximum at the coordinate $x=\frac{l}{2}$ and $y=d$. At any point P, distant x to the right from C,

$$t=H\sqrt{\left(\frac{2y}{x}\right)^2+1}$$

The maximum tension at the tops of the towers, R and R′ is

$$T=\sqrt{\frac{(Wl)^2}{8d}+\left(\frac{W}{2}\right)^2}$$

If a series of loads are suspended from the cable at given intervals, and the vertical deflection of the cable or the horizontal component of the stress is given, the equilibrium curve in which the cable will remain undisturbed under the given condition of loading may be graphically determined and the stresses found in the sections of cable between points of suspension of the hangers. As an example, assume a span of 200 ft.; a cable deflection of 25 ft. and ten hanger loads of 30,000 lb. with a panel length of 20 ft. The horizontal component of the tension will be $\frac{300{,}000\times 200}{8\times 25}=300{,}000$ lb. A parallelogram of forces may then be constructed from these data.

The tension in the cable at any point may be graphically determined as in Fig. 2. The tension at the point

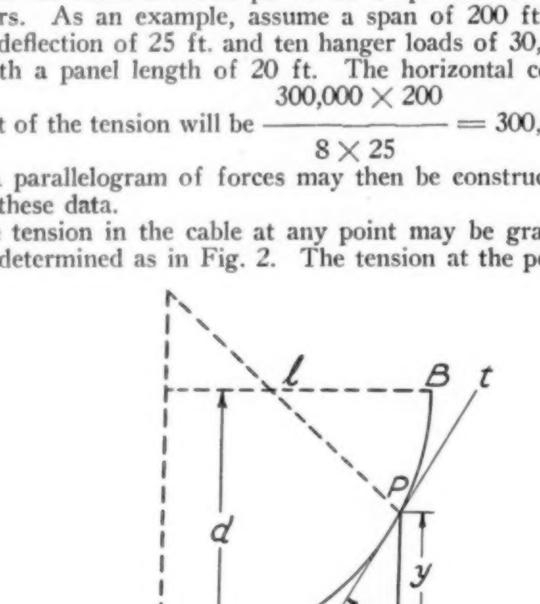


Fig. 2

P, whose coordinates, with respect to C, are x and y, is $t=Hx\sec\alpha=Hx\frac{EP}{ED}$. The greatest load on the hangers will occur when the span is fully loaded and not when the greatest concentration comes at a specific panel point, as is the case for ordinary truss spans.

When investigating the stresses in the towers and in the backstays it is seen that, if the cables rest on saddles on the tower tops, the cable tension on either side will be the same provided the cables and backstays have the same angles of inclination. If the angles are equal or if the horizontal distance, taken as AR between the point of support at the tower tops and the point of connection of the backstays with the anchorage is ¼ l the resultant of the compression in the towers will be vertical. If AD is less or greater than ¼ l there will be bending in the towers, the magnitude of this bending stress can be readily determined graphically. By the use of rocker towers, pin bearing at the base, the stresses from unbalanced horizontal forces are eliminated and movable saddles are not required. If α is the angle of the backstay to the horizontal the stress in the backstay will be $T=H\sec\alpha$. The vertical reaction of the cable at the towers is $V'=H\left((w+p)\frac{l}{2}+H\tan\alpha\right)$ and if the backstay has the same inclination as the cable it will also have the same vertical reaction so that the total compressive stress in the tower will be $S=(w+p)\,l$.

Stiffening Trusses.—To resist the tendency to distort under a moving load stiffening trusses are introduced, which distribute the reaction from the moving load uniformly over the cables and thus prevent oscillation and deformation of the roadway. In small suspension bridges the hangers are frequently connected to the lower chords of the stiffening trusses which are held down at their ends in a manner to permit free horizontal but no vertical movement. Stiffening trusses carry little load to the piers but function to distribute the live load concentrations uniformly along the cable.

The maximum deflection of the cable at the center of the span takes place when the central portion of the span carries full live load with no live load on the balance of the span. The cable sag under these conditions will be

$$d=\frac{wl^2}{8H}+\frac{w'l^2}{8H}=k\,(2-k)$$

where H = horizontal component of end reactions at R and R′

k = length of span covered by live load

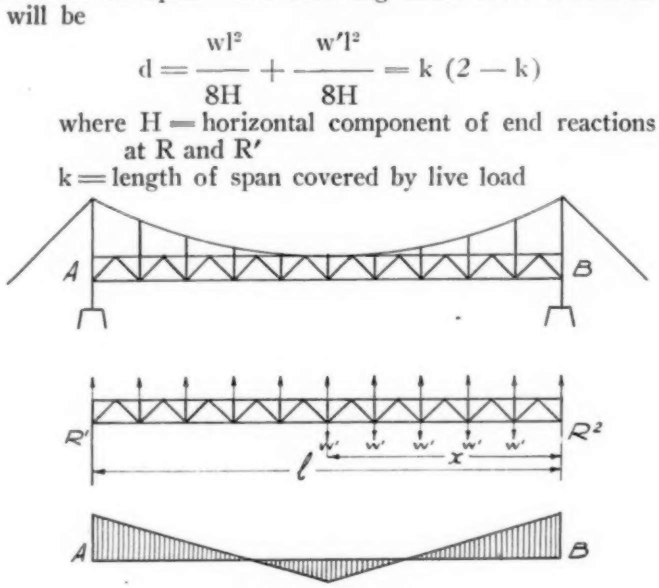


Fig. 3

w′ = live load per unit length

If R_1 and R_2 be considered as the vertical reactions of the stiffening truss at the towers then

$$R_1=\frac{w'x}{2l}(l-x)=R_2$$

The shear from live load is equal to the vertical reaction at each end of the stiffening truss and becomes a maximum numerically when the live load covers half the span, in which case the maximum shear $=\frac{w'l}{8}$. A shear diagram is illustrated in Fig. 3.

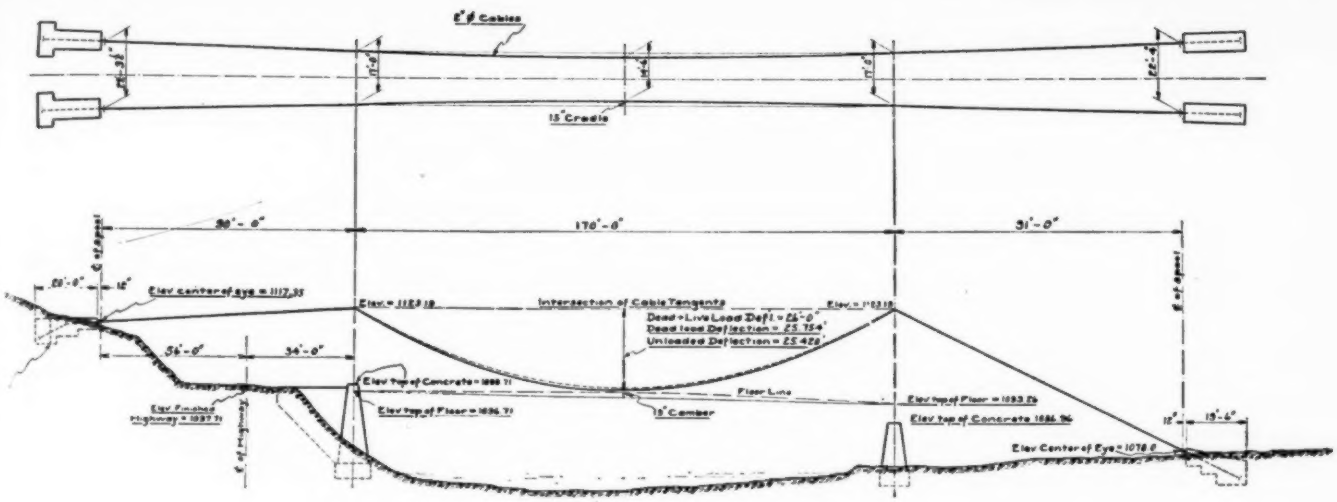


Fig. 4

The maximum bending moment occurs when x has the respective values of $\frac{2}{3}\,l$ and $\frac{1}{3}$ and is equal to $\frac{w'\,l^2}{54}$ or when the live load covers 0.618 l, for which position it becomes $M = 0.0451\ wl^2$. The point at which the maximum moment occurs is 0.382 l from the end of the span, and the moment to be provided for, allowing for the reversal of stress, is $\frac{1.75\ wl^2}{54} = \frac{w\ l^2}{31} = 0.0323$ wl^2. The maximum moment extends over 0.236 l at the center and diminishes uniformly to the ends; the average bending moment will be approximately 62 per cent of the maximum.

Wind Bracing.—The cables of small suspension bridges with small ratios of roadway width to span length are sometimes cradled inward from the tower tops to the center of the span, the hangers thus inclining inward. This cradling of the cables provides considerable lateral stiffness although the design is much simplified if the cables are allowed to hang in vertical planes. It is more economic and otherwise more satisfactory to retain simplicity of design by providing in the floor system full resistance to lateral forces. The entire wind pressure should be assumed to be carried by the suspended span to the supports at the towers.

If P represents a uniform wind load along the length of the span the moment from wind pressure is $M_w \doteq \frac{1}{8}\,Pl^2$, the maximum value of the total chord stress is $S = \frac{Pl^2}{8b}$, and the average chord stress will be $S' = \frac{2}{3}$ $S = \frac{Pl^2}{12b}$, where b is the horizontal distance between the central planes of stiffening trusses.

The economic ratios of side spans to main span are about ¼ for straight backstays and ½ for suspended side spans. Conditions at the site sometimes are the controlling factors of the length of side spans. The economic ratio of cable sag to span length between towers is about 1/10 with straight backstays and about 1/8 to 1/9 with suspended side spans. The width between centers of stiffening trusses or wind chords should not be less than 1/30 of the span. The depth of stiffening trusses should be about 1/35 to 1/50 for highway bridges with main spans up to 500 feet; it should be noted that the stiffening effects of the truss are more marked for short than for long spans, because of the variation in the ratio between live and dead loads.

Anchorage Design.—In suspension bridge design the main piers offer no difficulties that are not common to pier design for other types. The design of anchorages should be carefully studied as, though adequate and safe anchorage is absolutely essential to guarantee the integrity of the structure as a whole, considerable expense may be saved by proper attention being paid to this item of design.

When designing anchorages two primary conditions must first be investigated—stability against sliding and stability against tilting. The forces acting on the anchorage as a whole are the cable pull, the weight of masonry, the superimposed reactions and the resistance of the abutting earth or rock. A parallelogram of forces is drawn to find the total resultant and its direction. The resultant of all the external forces, plus the weight of anchorage, must intersect the base within the limits necessary to prevent uplift at the heel, and the inclination of the resultant from the normal must not exceed the angle of friction.

It sometimes may be necessary to slope or step the base so as to provide sufficient stability against sliding. Stepping the base is only effective when hard ground or rock is available. Where piles are used to resist toe pressure the caps should be embedded in the masonry and the piles battered on an angle parallel to the direction of resultant pressure.

Erection Methods.—To illustrate that the erection of the small suspension bridge is not as difficult as many believe, the processes of erection of a small bridge are described.

The following divisions of the work of construction will be considered: piers, anchorage, towers, main cables, suspenders, stiffening trusses and floor system. The line diagram illustrates the erection of a bridge with a main span of 170 ft., which was designed for one lane traffic with H-15 loading, plus 25 per cent impact and wind, snow and ice loads. Each of the two main cables consisted of one 2-in. diameter galvanized bridge cable carried over the steel towers on cast-steel saddles. The backstays were of the straight (unloaded) type. These cables have a mid-span deflection under full load of 26 ft., and were cradled with a horizontal middle ordinate of fifteen inches. Nothing different from ordinary practice is required in the construction of piers and anchorages.

There are two general methods usually adopted for

the erection of the main cables. In the layout illustrated (Fig. 4) the cables were laid out across the river and extended from anchorage to anchorage to which the ends were attached. A bight of the cable was then hoisted at each tower and placed on the saddles. The gin pole and tackle used in erecting the towers were used for hoisting the cables and seating them on the saddles. Another method of cable erection that is sometimes used is to pull the cable from one anchorage up over the tower saddles and then to the opposite anchorage. When this is done a pull line equal to the length of the cable is required, care being taken to see that, by the use of wooden rollers or blocks, no injury is done to the main cables as they are drawn over the saddles. It is important, when erecting by this method, to see that the cables are not suddenly released at the reeling end, and to prevent this a snubbing line with a suitable clamp should be used.

The method first described is safer and simpler and should be used wherever circumstances permit. It is easily seen that, where the ends of the cables are securely anchored before the tension is applied, this method guards against the possibility of runaway ends.

The reels on which the main cables are wound should be properly mounted so as to rotate when the cable is being unreeled. Where space is available and conditions permit, the cable may be unreeled by rolling the reel along the ground. Care should be taken to protect the cable from injury to the individual wires and to the galvanizing. It is recommended that, if the cable is paid off by rotating the reel a brake consisting of a strong piece of timber be used to act as a lever to insure smooth and even unreeling.

The cables must first be adjusted to the correct mid-span sag by varying the length adjustment in the cable sockets at the anchorages, at the same time the cables must be worked over the saddles. It is necessary carefully to check the cable deflection and this may most easily be done with a transit or level. It is most important, however, to see that the correct no-load deflection is obtained. If this is not accurately done it may be difficult to close or properly align the sections of the stiffening trusses when they are subjected to full dead-load conditions. Care should be taken first accurately to calculate and establish the no-load cable deflection, and second, the position of the towers must be checked during the adjustment of the cables so as to see that the correct calculated tower positions are maintained. During erection of cables the towers may or may not be vertical, depending upon several factors. A plumb line from the top of the tower to the base is a simple and effective means of determining tower position. Tower bending must be constantly watched during the erection of the suspended loads and the calculated safe bending of the tower must never be exceeded. It is thus seen that the elimination of tower bending by the use of rocker towers simplified erection considerably.

After the main cables have been properly adjusted for the main and side spans cable clamps are placed on the cables so as to bear on each side of the saddle and thus prevent slippage during the rest of the erection process.

The cable bands and the suspenders are usually erected at the same time together with the floor beams and stringers. Sometimes, however, all the suspenders are erected before any of the floor system is placed. In either case erection should proceed simultaneously from each tower, or under certain circumstances starting at mid-span and proceeding simultaneously toward the towers. The loads must be kept balanced and thereby insure a balance of tension and load on both the cables and towers—this is important.

The spacing of the cable bands, when band points are not previously marked on the cable, should be made according to the correct panel lengths by measuring horizontally and ignoring the actual cable curve lengths between bands. The Roebling Company recommends that the cable band and saddle point positions be marked on the cables at the time they are being measured for correct lengths at the place of manufacture. The cable bands should be set out of position slightly above their final point on the cable, for, when the final adjustments are made, it is much easier to move the bands slightly down the cable curve than to move them up the cable. It is a good scheme to use a template equal in length to the horizontal panel spacing, and then adopt a temporary cable band setting slightly in advance of the final positions.

To erect cable bands and suspenders a movable working platform may be used. It is recommended that a sheave be mounted on the main cable and a platform hung from the sheave. The sheave is allowed to travel on the cable as a track, being controlled by a connecting rope running to the tower. By the means of two such rigs two crews can work along the cable until they meet at the center of the span.

The suspenders on small bridges are generally connected to the floor beams though sometimes the stiffening trusses are designed to take the suspender connections. When erecting the suspender system the deformation of the cable curve under the concentrated loads causes the partly erected bridge floor to assume distorted shapes. When the uniformly distributed dead-load is all placed the cables and the floor system assume their correct positions. When the suspenders are adjusted each must take its proper share of the load. Starting at each end, and proceeding simultaneously toward mid-span, all suspenders should be adjusted to give the calculated floor elevation and camber.

The stiffening trusses are, of course, erected after placing the suspenders, floor beams and stringers, by starting simultaneously at each tower and proceeding toward mid-span. The truss connections near the center cannot be finally connected until the truss has been closed at the center. As the truss is erected a wave or rise in the truss chord is noticeable, reaching its maximum at mid-span and a smooth curve is not attained until the full dead-load is in place, after which there is no difficulty in aligning the trusses.

The erection of a small suspension bridge is seen to be simple, provided that certain basic requirements have been taben care of as stated. Calculations, measuring and marking must be accurately done and close supervision exercised to see that everything is properly done in the field. It is therefore evident that the most important and difficult matter is the planning and supervision, as little skilled labor and special equipment are required to perform the actual work economically and satisfactorily.

For a more detailed discussion of suspension bridge design and erection the reader is referred to "A Practical Treatise on Suspension Bridges" by D. B. Steinman, published by John Wiley and Sons.

Acknowledgment.—The foregoing is a paper presented Jan. 17 at the 30th annual convention of the American Road Builders' Association in connection with the report of the County Committee on design and construction of low cost bridges.

SELLING CONSTRUCTION TO PUBLIC THROUGH A UNITED INDUSTRY

By Edward J. Mehren
President of the Portland Cement Association

GREAT success is achieved most easily when we cooperate with great forces. It is easier to swim with a current than against it. It was not possible in the '90s to launch a highway movement of grand proportions, for there was then no tide moving in that direction. But when the automobile put the public on the open road, there *was* created a great tide and highway enthusiasts, riding on it, transformed road transportation in an incredibly short time.

So will it be with recovery from this depression. Construction will be the road of recovery only if the tide so runs; only if economic forces dictate that money and men can soundly be employed on construction as the way out.

Look at Some Facts.—Does construction lie in the tide of economic recovery. Here are a few facts:

1. Housing construction activities have been below normal since 1928, and there is now an estimated shortage of facilities for 700,000 to 800,000 families.

2. Not only is there a dearth of new homes, but old homes have been neglected and millions of them sadly need rehabilitation and modernization.

3. Factory and office buildings similarly need rehabilitation and modernization.

4. Enforced economies have caused our civic works to fall behind needs—in paving, in schools, hospitals, public buildings of all sorts, in street widening and extensions and in other civic improvements.

5. The public conscience is aroused over the condition of our slum areas, and, belatedly, it is realized that our racing prosperity of the '20s profited not at all the living accommodations of the low-income brackets in our cities.

6. Again the public conscience has protested against the condition of our streams and lakes. Our brooks and rivers are defiled by sewage. New York harbor is a cesspool. These Great Lakes, on which we meet today—God's greatest gift of fresh water in the world—are fouled by the very peoples who would draw refreshment from their depths.

7. Our road system, satisfactory in some rural sections, is totally inadequate elsewhere and, in our metropolitan areas, cries for widening, new arteries, separated crossings.

In addition, the public has turned to construction as the only means of soundly employing public credit in an offensive to create jobs, reduce suffering, hasten recovery.

What Shall We Do?—The tide, then, is setting in our direction. Shall we help it or ignore it? Shall we try to accelerate it or let it find its own pace?

The questions answer themselves.

Now we are inert. Our attitude reminds me of a story about a celebrated English author of the Samuel Johnson period. Returning late from a session with convivial companions, he heard a call from the gutter, "Help me up." Our friend was too shaky to give assistance but he wanted to be agreeable. So he replied, "I can't help you up, but I'll lie down beside you."

So it is with the construction industry. Here we lie, punch drunk, not liquor drunk, waiting for the juggernaut of depression to run over us.

True, some valiant souls and groups have waged modernization campaigns, and a handful of the faithful have participated in and supported the work of the National Committee for Trade Recovery. Some of the specialty companies, like Johns-Manville, U. S. Gypsum and American Radiator, have gone after business. They have still believed in salesmanship; they have kept faith that human minds can still be influenced.

But, by and large, the great construction industry has gone into hibernation until this winter of our sorrow shall have passed.

To illustrate our inertness, note what we could have done to this depression. We could have laid before the public—for its own good—facts such as these:

1. The distinction between wasteful current expenditures in government and wise investment of public funds.

In other words, we should have opposed with sane program the uncompromising and ruthless economy programs of government economy leagues, chambers of commerce, and real estate interests.

2. Employment created by construction.

3. The economy of construction now, as compared with any year since the war.

The automobile industry emphasizes the low present prices of cars; the clothing stores tell you that suits, and dresses are down to pre-war prices. "Ships and shoes and sealing wax and cabbages"—and possibly kings—are cheaper than ever—and their sellers tell it to you from the housetops and through the advertising pages of our newspapers.

But where is the voice of construction telling the public that in public and private building operations it can now get unheard of bargains?

4. The use of relief funds for jobs as far as possible instead of doles.

This would not have been a program of froth and sound.

These are facts the public should have had—and should still have; facts that would have assisted—and will still assist—the orderly fighting of this depression; facts that offered—and still offer—an extraordinary opportunity for the construction industry to tell the public the relation of construction to the public welfare.

We Need to Fight.—Thus far, we have failed in our opportunity, failed in our duty. What shall be our future course?

I plead for militancy, for shouldering our responsibility to the public and expressing that responsibility vigorously.

Note what other large industries are doing. There are others worthy in size to be classed with ours—farming, the railroads, the automobile industry. Farming surely is unified and assertive. There is no one in this country that does not know today the plight of the farmer.

The railroads have formed themselves into battle array. Their case is vividly put in the press, in posters, before chambers of commerce and other bodies. They are fighting for tax reduction; they are vigorous in demanding regulation of trucks and busses.

The motor industry more than any other stands out for its aggressiveness. Their colors are still at the masthead. They proclaim faith in America, faith in an economic hereafter, determination to entice lazy dollars out of hiding by offering superb values. If they get the consumer dollar rather than we, impartial judges must say that the reward has gone where it belongs. Above all they are still salesmen. They believe in aggressiveness. They have faith that human minds can still be influenced.

Why Have Earlier Attempts Failed?—In the past, a number of attempts to unify the industry have been made. They have proved abortive. The failure, to my mind, has been due to two causes:

1. Lack of vivid objective external to the industry itself.
2. Inability to interest the manufacturing group, who have the financial resources to back such a movement and the selling genius to accomplish its objective.

What should that objective be?

My answer is this: To sell construction to the public, to build business for the industry, to create demand for construction work. This is a project which the manufacturing group can understand and which their selling genius can accomplish.

Of course, I am fully in accord with efforts at internal coordination, long-range planning of construction and similar needed activities. These should not and would not suffer, but essentially I would make the body militant and you can make it militant only when it has an object external to itself.

We should work through definite projects, not generalities. I would be among the first to object to the ordinary type of goodwill campaign, to an effort to tell the public merely how good or beneficent we were. Right now we could point out the relations of construction to recovery which I have mentioned:

1. The distinction between wasteful current expenditure in government and wise investment in public works.
2. The employment created by construction.
3. The economy of construction now—in 1933.
4. The wisdom of using relief funds so far as possible for work rather than doles.

Other projects press for attention and in great numbers.

The instrument, too, is ready—in the Construction League. Let's make a valiant effort to add to its fellowship of architects, engineers, and contractors, the leaders of the manufacturing group.

Construction does, indeed, lie in the tideway of recovery. The current presently should begin to move. Let's not be passive. Let's speed its pace. From inertness let us become a militant force for recovery, voicing our views, exerting our strength wherever we can undam the current and facilitate its flow. Let's carry aloft the banner of courage, and, above all, the banner of faith in our ability to sell, to carry conviction to the mind of America.

Acknowledgment.—The foregoing is a paper presented Jan. 20 at the Highway and Building Congress, Detroit.

Illinois Diversion Situation

Illinois highway income, exclusive of federal aid, consists of state vehicle license fees amounting to about $18,400,000 and gasoline tax income amounting to about $29,100,000. The state's share is about $37,800,000, consisting of the entire license fee and two-thirds of the state gas tax money. There is distributed to the counties in proportion to the gasoline tax payments of each, one cent per gallon or about $9,700,000 for the entire group. All of these taxes were levied distinctly as highway construction and maintenance funds and it is not believed that the use of any portion for any other purpose can be legally sustained.

Illinois diversions run something like this: Last spring the legislature authorized a committee consisting of the governor, state treasurer, and auditor of public accounts to apply on current expenses unexpended balances remaining to the credit of any state department. Being interpreted, that measure conveyed authorization to remove from the highway department sums then accrued to meet the cost of the year's construction program. Approximately $16,000,000 was thus removed, reducing the state's program by one-third.

Under threat that unless they did so the state tax rate on real estate would be almost doubled, a bond issue of $20,000,000 was approved by popular vote, to wipe an issue of state tax warrants used to defray relief expenditures during 1931-1932. This bond issue is to be paid out of the counties' share of the gas tax proceeds and during the next twenty years will require $31,000,000, an average of $1,550,000 per year or about $2,000,000 for the first year.

A few weeks ago the legislature passed Senate Bill No. 30 authorizing county boards to spend for unemployment relief the entire available current income from counties' share of the gasoline tax, from January 1 to July 11, 1933, amounting to about $5,000,000. More recently the same body passed the amended Senate Bill No. 4, known as the Meentz Bill, authorizing the counties to issue bonds for unemployment relief amounting to six times the previous year's share of the gas tax fund received by each county, the bonds to be retired out of future gasoline tax money allotted to the counties. This bill, therefore, authorizes the issuance of over $58,000,000 of county bonds, which with interest over a 20 year period, would cost nearly $90,000,000.

Should this entire amount be issued the principal and interest payments on a 20 year 5 per cent basis would average about $4,500,000 annually while the first year's payments would be around $5,800,000, about 60 per cent of the total annual gas tax allotment to the counties on the 1931 basis. The same percentage of its gross gas tax revenue would be diverted in the same way by any county which issues its legal quota of these bonds.

Gasoline tax income has begun to shrink considerably and the counties' share of the 1932 tax undoubtedly will be below the 1931 figures—while bond interest will remain constant. Therefore, shrinkage of income will be reflected directly in reduction of revenue available for road maintenance and construction. Maintenance will come before new construction, so the funds available for county highway building in Illinois, from gasoline tax sources, are going to be very limited, according to present prospects.

It will not be forgotten that Illinois has also borrowed from the Reconstruction Finance Corporation for relief, a total of $20,300,000 to be paid back out of its future federal aid allotments.

So summing up the disastrous effects on highway finance of recent Illinois legislation we find $16,000,000 withdrawn directly from the state highway funds, $31,000,000 withdrawn during the next 20 years to pay for last winter's relief, $5,000,000 authorized to be spent between January 1 and July 11, 1933, from current gasoline tax income to the counties, an authorized bond issue to cost $90,000,000 to be financed from counties' share of the gasoline tax during 20 years, and $20,300,000 borrowed from the Reconstruction Finance Corporation, to be repaid from future federal aid allotments—a total of $162,300,000.

How to Build Bituminous Plant-Mix Surface of *GRADED AGGREGATE TYPE*

THERE are two general groups of "plant-mixes" using bituminous materials, and mineral aggregates, and they cover a wide range of traffic-support. The first group, according to "Low Cost Roads and Bridges," a new book just out by V. J. Brown and C. N. Connor, from which this article was taken, is the hot-mix type, wherein the aggregates and bitumen are mixed in standard central mixing plants and the resulting mixture is placed upon a suitable foundation to a compacted depth of from two to four inches. The foundation may or may not be the same mixture as the top course. The second group, according to these authors, is the cold-mix type, wherein the aggregates and bitumen are mixed without heating either to high temperatures. Some heating (relatively it is only warming) is done to lighten the viscosity of the bitumen for coating ability, and to remove surface moisture from the aggregate.

It is believed that on extensive work, and under certain conditions the cost by plant-mix will compare very favorably with that of the road-mix method. It is evident that the production of aggregate, delivery to road bed and finishing will be approximately similar in those cases where all new material goes through a central plant before placing on the road. We may, therefore, properly balance the cost of plant-mixing (cold-mix type) against that of spraying and mixing on the road, with an appreciable credit in the way of reduction of bituminous content in favor of plant-mix.

Advantages of Plant-Mix.

1. Not seriously affected by changing weather conditions.
2. Increase in length of dependable working season.
3. It is unnecessary to detour traffic during operations.
4. As both aggregate and bitumen are weighed, uniformity of mixture can easily be obtained.
5. Excess moisture is removed from the aggregate in hot mix types.
6. A minimum quantity of high viscosity bituminous material can be used.

Graded Aggregate Type.—There are portable types of hot-mix plants that conveniently construct graded aggregate type surfacing as a low cost road. The plant operates as a central plant but is readily moved from place to place. It should not be confused with the type of portable plant that moves along the road. It is portable in that the superstructure can be easily lowered and, along with other parts, readily moved to a new central location. With this type of plant the mineral aggregate is dried, and the bitumen is heated to about 250 to 300 degrees before mixing. The aggregate analysis curve, while not exactly conforming to the curve of maximum density, must have certain limits. The following discussion of this type of surface is based on the specifications of the Minnesota Department of Highways. The surface is a mixture of mineral aggregate, filler, and bituminous material. It is placed on a prepared roadbed.

Materials.—The aggregates for this type of construction follow closely that employed for road-mix graded aggregate type except that stones larger than 1 inch screen are crushed.

The combined mineral aggregates and filler should conform to the following grading:

	Per Cent
Passing a 1 inch circular screen	100
Passing a ¼ inch circular screen	50 to 70
Passing a No. 10 mesh sieve	35 to 60
Passing a No. 200 mesh	7 to 14

The bitumen content shall be from 5 to 7 per cent of total mix by weight.

For each 100 pounds of combined mineral aggregate and filler from 5 to 7 pounds of bitumen should be used.

The per cent bitumen is based on natural sands and gravel pebbles, the requirement may be higher for crushed rock and stone screenings.

The proportions within these limits must be fixed by the engineer and the contractor must so operate as to obtain the maximum uniformity possible.

Coarse Aggregate.—The coarse aggregate may be either gravel pebbles or crushed rock. If gravel is used all of the oversize material which is smaller than 6 inches should be crushed and uniformly mixed with the uncrushed gravel. The coarse aggregate should conform to the following grading:

	Per Cent
Passing a 1 inch circular screen	100
Passing a ½ inch circular screen	25 to 75
Passing a ¼ inch circular screen	0

A tolerance of 5 per cent is permitted on the part passing a ¼ inch screen but such percentage is considered as fine aggregate and must meet the specification requirements for fine aggregate.

The coarse aggregate, if gravel, should pass an abrasion test in which the maximum loss for uncrushed gravel shall be 14 per cent and for crushed gravel 22 per cent. If crushed rock, it should have an abrasion loss of not more than 8 per cent.

The coarse aggregate should not have a clay coating after it comes through the dryer and at that point should not contain clay lumps which will be retained on a No. 10 sieve.

Fine Aggregate.—The fine aggregate should be composed of particles of durable rock and should be free from coatings of clay or other matter that would prevent a thorough coating of the particles with bituminous material in the mixing.

The fine aggregate plus filler must conform to the following grading:

	Per Cent
Passing a ¼ inch circular screen	100
Passing a No. 20 mesh sieve	40 to 75
Passing a No. 200 sieve	10 to 20

The fine aggregate must not contain more than 5 per cent by weight of shale. It should not contain clay of such a nature that it forms balls or lumps which will not pass a 10 mesh sieve. The clay most conform to the

requirements of a filler. The maximum per cent loss in the elutriation test should be 10 per cent.

Filler.—Additional filler is not necessary unless the sand in the pit is found to be deficient in suitable 200 mesh material.

The filler may be earth or dust filler and should contain not more than 15 per cent of colloids. It should be of such a nature that when once thoroughly coated with oil they will not separate therefrom when in contact with water.

Bituminous Materials. — The bituminous material should be free from water, should not foam when heated to 250° F. and should meet the following requirements.

The bituminous material and 100 penetration residue derived therefrom should be homogeneous.

Asphaltic residue of 100 penetration	Minimum 75 per cent
Viscosity, Saybolt-Furol at 122° F.	Maximum 1500
Flash Point, not less than	225° F.
Soluble in carbon tetrachloride, not less than	99.65 per cent
Insoluble in paraffin naphtha	12 to 20 per cent
Ductility of 100 penetration residue at 77° F., Not less than (Cm.)	100
Ductility of 100 penetration residue at 39.2° F., Not less than (Cm.)	6
Loss at 325° F., 50 gms. 5 hrs., not more than	5 per cent

Methods of Test.—All tests shall be made in accordance with the methods described in Tentative Standard Specifications for Highway Materials and Methods of Sampling and Testing, published in 1931 by the American Association of State Highway Officials.

The per cent colloids in the filler must be determined by mechanical analysis with Bouyoucas hydrometer according to method described in the October, 1931, issue of Public Roads.

Construction Methods.—The aggregates and filler are dried in a revolving cylinder at a maximum temperature of 225° F. and so that they contain less than 1 per cent moisture by weight, and after drying, they are divided into two sizes on the ¼ inch screen.

The coarse and fine aggregate are stored in separate moisture-tight bins. The correct quantity of coarse and fine aggregate (containing the filler) at a temperature not less than 175° F. should first enter the pug mill type mixer and last the bituminous material at a temperature of 175° F. to 225° F. The temperature of the bituminous material should be within 10° plus or minus of a temperature designated by the engineer within this temperature range. The batch weighed must not be less than 1,000 nor more than 3,500 pounds. The entire batch is discharged at one time. All materials including the bituminous material is accurately proportioned by weight. The equipment for weighing aggregates conforms to the specifications given on page 221 of the 1930 Convention Proceedings of the American Road Builders' Association for separately weighing the correct proportions of the fine and coarse aggregate. At least 10 standard 50-pound test weights are available at all times for use in checking the scales.

The mixing continues for a period of at least 40 seconds after all the ingredients are in the mixer or longer if necessary to obtain a mixture with all particles uniformly coated with bituminous material.

The mixture is then hauled to the road immediately after mixing and except for 20 tons per mile which is placed in stock piles it is deposited in a continuous windrow of uniform cross section. The engineer does not permit mixing and dumping when the roadbed is wet or when there is a likelihood of rain within 5 hours. Whenever the total thickness after compaction is two inches the mixture is dumped for spreading in one layer but when the surface after compaction is three inches thick then it is to be spread in two layers and therefore material for only half the total thickness is windrowed at one time. The depositing begins at the point farthest from the plant and proceeds toward the plant unless otherwise directed by the engineer. All trucks have pneumatic tires and maximum loads are not more than 6 tons.

Before final spreading begins all the material is moved back and forth across the road by means of pneumatic tired power patrol blades and sufficient number of times so that the material will lay smoothly when spread. If the mixed material should become wet before it is laid down and satisfactorily compacted it is manipulated back and forth on the road until the mixture contains not more than 1 per cent moisture by weight. It is then spread to the depth and width shown on the plans.

During construction the surfacing receives sufficient maintenance with pneumatic tired power patrol graders or other approved equipment, to remove all ruts and waves and insure a smooth surface. This maintenance must be especially vigorous in the days immediately following the placement of the mixture. Should the wearing course become unsatisfactory and packed so firmly that blading will not correct it, it must be scarified and relayed as the engineer may direct. All patch work necessary to be done while the project is in progress must be done promptly.

Basis of Payment.—Payment for surfacing is best made at the contract price per ton on the basis of batch weights at mixing plant.

Construction Costs.—On 1932 projects in Minnesota involving 60,000 tons, bid prices for the completed work ranged from $1.95 to $2.25 per ton. The state prepared the subgrade. The 60,000 tons was in four jobs of 15,000 each. Three of the jobs called for approximately 2 inches of thickness on a 25 ft. width while one job was built with a thickness of 3 in. The subgrade in each case was 32 ft. wide.

Acknowledgment.—This article was abstracted from Chapter V of the new book just out entitled, "Low Cost Roads and Bridges," by V. J. Brown, Assoc. Editor of Roads and Streets, and C. N. Connor, Engineer Executive, American Road Builders' Association. This excellent book tells how to build all types of low cost roads as well as giving information on economics, traffic, and design.

▼

Auto Fatalities Decrease

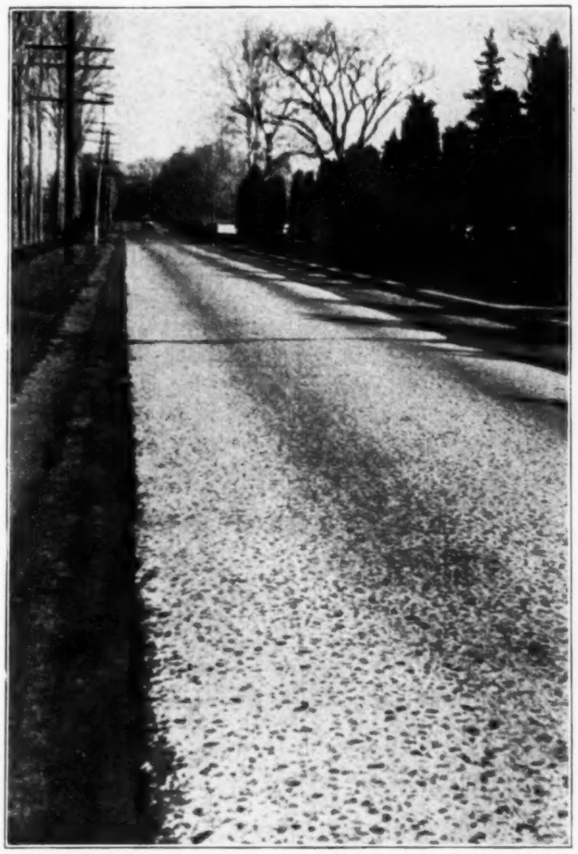
IN 1931 motor vehicle fatalities totaled 34,000. Preliminary estimates for 1932 indicate a decrease of 10 per cent. Gasoline consumption was about 5 per cent less in 1932 than in 1931, so motor car mileage decreased about 5 per cent. That accounts for half the decrease in automobile fatalities. The other half is partly accounted for by greater caution, partly by the improved condition of road shoulders, and partly by an increase in the number of street crossings having stop and go signs. Many old vehicles have been scrapped and not replaced by new ones; but, on the other hand, the average age of the cars in use has increased. Hence the average condition of the vehicles probably has not improved.

During the three years 1929 to 1931, railway passengers killed per annum averaged 62, only 16 of whom were killed while on the train. During those years the average number of passengers carried per annum was 763,000,000, of whom only 16 were killed on the train. This comparison serves to show how enormous is the risk of riding in an automobile compared with the risk of riding in a train.

Building a Modern Cement-Bound Macadam Pavement

CEMENT-BOUND macadam is a pavement constructed by pouring a cement-sand grout having the consistency of rich cream over a layer of coarse rolled stone. The grout runs into and fills the voids in the stone, where it hardens, forming a rigid slab much like concrete, but containing a higher percentage of coarse aggregate.

Cement-bound macadam was first used in Scotland in 1872-3, and pavements built at that time, though now 60 years old, are still in use. The first cement-bound macadam in the United States was constructed in 1906 and this type of pavement was actively promoted for both roads and streets until about 1920. Most of the cement-bound macadam built during that period are still in service, though they are now from 12 to 26 years old, are on some of our heaviest traveled highways, and were built for much lighter weight vehicles than they have had to carry.



An Old Cement-Bound Macadam on the Shore Route, Near Norwalk, Conn. Though It Is Only 6 in. Thick and Carries Heavy Traffic, It Has an Unbroken Edge, in Spite of a Low Shoulder

Today we are confronted with the problem of surfacing a larger mileage of secondary roads. Construction on these roads is largely in the hands of counties and townships, jobs are short and the work is done by the county itself, on a day-labor basis, or by the smaller contracting outfits. It is for such roads that cement-bound macadam is proposed.

Five sections of this type of pavement were constructed in 1932 to determine how modern methods and up-to-date equipment could be used to the best advantage, what daily production could be expected and the approximate cost of the pavement.

Two such sections were built by county maintenance forces in Morris County, and one in Somerset County, New Jersey. Pennsylvania built a mile on a minor state highway in Northhampton County, using state maintenance forces and equipment, and New York state contracted for a mile which was built near the city of Newburgh.

Much the same methods were used on all these jobs, but the one in New York was built last, had the benefit of the experience gained previously and may be taken as an example of modern practice.

Qualities Required for Stone.—On the New York job, the stone was a trap from $1\frac{1}{4}$ to $2\frac{1}{4}$ in. in size. It was hard, tough and exceptionally clean. This latter is especially important since any smaller particles settle to the bottom where they fill the voids in the stone, prevent penetration of the grout and thereby reduce the thickness of the slab. Hardness and toughness are important for the same reason, because small pieces which will fill some of the voids are broken from soft or friable stone by handling, rolling, or by the wheels of trucks hauling grout. When only softer stone is available, larger sizes are used, to increase the size of voids and assure penetration. Construction is also arranged so that rolling is not excessive and there is a minimum of construction traffic over the stone.

Preparation of Subgrade.—The subgrade is first brought to proper elevation and the earth shoulders are built up to the level of the finished slab, if they are not already that high. Lines are stretched along each shoulder where the edge of the slab will come, and the edge of the shoulder is made straight and vertical by hand, to serve as a side form. This work is best kept just ahead of stone spreading, else rains will destroy the vertical edge and it will have to be rebuilt.

Spreading the Stone.—The stone is spread by bottomless boxes supported on runners that rest on the subgrade. Trucks dump into these boxes, at the same time dragging them forward. The lower edge of the back of the box acts as a strike-off template and may be set so that any desired depth of stone is secured. If the runners are long, so that they bridge minor inequalities in the subgrade, and the sides of the box are high enough to prevent spilling and permit a full box whenever the box is moving forward, a surprisingly even surface is secured.

It is best to keep stone spreading only a day's run ahead of grouting. Otherwise heavy rains may wash dirt into the stone, necessitating removal and cleaning. And if there is a long stretch of stone in place, any traffic over the roadway will tend to crush and abrade the stone and get it dirty.

Rolling the Stone.—The loose stone is compacted with a roller weighing from 7 to 10 tons. Either the three-wheel or tandem type is satisfactory but the latter seems to produce a more even surface. Except for smoothing up the surface, all that rolling needs to accomplish in this type of pavement is sufficient compaction to reduce voids and keep the wheels of grout trucks from forming ruts in the stone. Keying of the stone, so desirable in other types of macadam, is of no consequence here.

About 20 per cent compaction can be expected. If

the stone lies directly on the natural soil, some stone will be pushed into the subgrade by rolling and will not be available for grouting. If the subgrade is an old gravel, macadam or other hard surface, no stone should penetrate it. On the jobs built during 1932, stone was spread to a loose depth of 7½ in. to secure a slab thickness of 6 in.

Expansion and Contraction Joints.—On the New York job, expansion joints were constructed by trenching the rolled stone, installing premolded joint material at right angles to subgrade and center line and compacting stone about it. No bulkhead was used. Subsequent rolling did not seem to disturb the joints. One-inch joints were put in at 300-ft. intervals without intermediate contraction joints.

A longitudinal center joint of the dummy type was made by a 1 by 2-in. wooden strip held in place on the subgrade by 40 penny spikes. The strip was placed with its long axis vertical, to reduce the slab thickness so that, if longitudinal cracking occurs, it will be straight and in the center.

Similar strips were installed transversely on previous jobs, to act as contraction joints.

Proportioning, Mixing and Placing Grout.—After the

Stone Is Spread Accurately by a Bottomless Box Set on Runners That Rest on the Subgrade

stone is rolled and checked to see that it has proper depth and an even surface, grout is poured over it. On recent construction, grout was proportioned at a central plant and transported to the job in truck-mixers that mixed it enroute. While this proved entirely satisfactory, it is possible that, in some localities at least, a small paving mixer running on the stone and spouting the grout directly into place would prove more economical.

Grout was proportioned one sack of cement to 2 cu. ft. of sand and about 7½ gals. of water. Sand was regular concrete sand graded between the 100 mesh and ¼-in. sieves.

The grout trucks back into position on the stone and a chute is attached which distributed the grout. But the grout runs down the chute with such velocity that it washes depressions in the stone and these would make a rough riding surface. So a box containing baffles is attached to the end of the chute, and the grout is discharged vertically downward through holes in the bottom of the box. On the New York job, sacking was tied to the distributor box in such a way that grout discharged onto the sacking and then ran off onto the stone.

After grouting, the pavement was immediately rolled with a 5-ton tandem roller to aid penetration of the

Grout Is Hauled in Truck-Mixers and Deposited on the Stone Through a Distributor Which Checks Its Velocity

grout by movement of the stone. Sometimes additional grout was required on the stone after this first rolling. The surface was then checked with a long straight-edge and irregularities were corrected by adding or removing stone. Piles of ¾-in. stone were left at intervals along the shoulder to be used in filling depressions.

Final Rolling and Finishing.—After initial rolling, the slab was allowed to stand for 30 minutes or more before final rolling was begun. This was continued until the surface of the slab was true and even and any excess grout had been worked out.

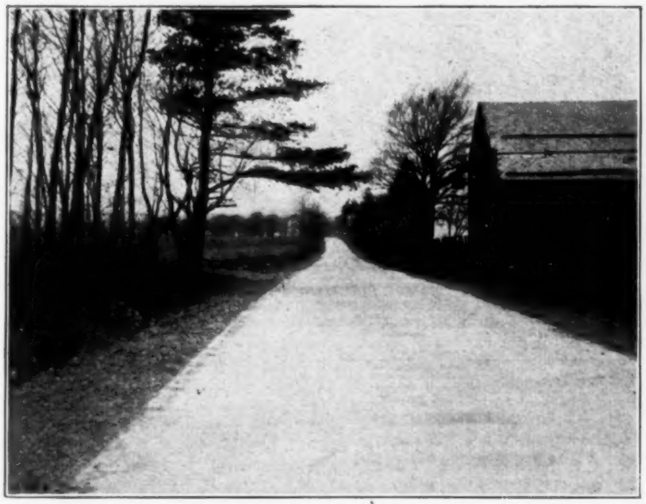
Surface grout was then distributed with wooden floats, to cover patches where stone protruded, and the final finish was given by burlap belts, the first being dragged over the surface with a sawing motion and the second dragged forward without any sawing.

On the Pennsylvania job, a water line was run along the road under construction and the pavement was cured with wet burlap kept on the surface for 48 hours. In New York, water under pressure was not readily available so curing was dispensed with and hardening was accelerated by adding calcium chloride to the grout. Two pounds of calcium chloride was added per sack of cement. It was put in solution and placed in the mixer drum with the mixing water.

Much of the New York cement-bound macadam was

A Sack, Fastened to the Distributor in Such a Way That Grout Ran Onto the Sack, Then Onto the Stone, to Prevent Disturbance of the Stone

Rolling the Grouted Stone Aids Penetration of the Grout and Irons Out the Surface



A Section of Cement-Bound Macadam Completed by Maintenance Forces of the Pennsylvania Highway Department in 1932

laid when temperatures were only a little above freezing. Under those conditions, final rolling and finishing could not have been completed for 2 or 3 hours after grouting, because the grout would harden slowly. But with calcium chloride in the grout, it hardened even more quickly than on previous jobs built in warmer weather but on which no calcium chloride was used, so that rolling and finishing were kept close to the grouting and little night finishing was necessary.

Construction Organization.—The crew consisted of the following men:

Men	*Occupation*
3	Fine grading and making vertical shoulders
2	Dumping stone trucks and spreading stone
1	Foreman over above
1	Loading water and calcium chloride
1	Weighing sand
3	Loading cement
3 to 5	Unloading and spreading grout
2	Finishers
1	Night watchman
2	Rollermen
2	Contractors acting as foremen, etc.
19 to 21	Total (the larger number was required for normal production).

The equipment used was as follows:

Number	*Item*
1	Portable sand bin and aggremeter
1	Industrial crane
1	Handy truck
2 to 5	2½ and 3 cu. yd. Rex and Jaeger truck-mixers
2	Automobiles
1	Steam shovel
1	Gas powered glade grader
2	Stone spreader boxes
1	10-ton Galion, 3-wheel gas roller
1	5-ton steam tandem roller
	Picks, shovels, brooms, etc.

Trucks hauling stone were furnished by the material dealer as stone was purchased "delivered."

Five truck-mixers were required for normal production. The average length of haul for grout was 3.16 miles. Drivers are not included with the crew because mixer-trucks were rented and rental included drivers.

Water-Cement Ratio.—The average water-cement ratio, including moisture in the sand, was 7½ gal. per sack. An average of 4.05 bags of cement was used per cubic yard of slab, or 0.675 bag per square yard for a 6-in. thickness. The average proportion was 1:2:8.35, based on the dry, loose volume of both sand and stone. An average of 47.2 sq. yd. was grouted with a 3 cu. yd. truck load of grout.

Construction Progress.—Because of low temperatures and early darkness, the average working day on the New York job was only 6½ hours long. With that as a handicap, the average of the three best days' progress was 743 lin. feet, or 1486 sq. yd. per day. On the Pennsylvania job, the average of the three best days' run was 1087 ft. It seems probable that a well organized crew can be counted on to lay 200 sq. yd. of cement-bound macadam per hour.

Costs.—The cost of the New York pavement, excluding excavation and earth shoulders, but including contractor's profit, was $1.08 per square yard, or $11,400 per mile. The cost of the Pennsylvania job, on which there was no profit, since it was done by the state's own forces, was $0.95 per square yard or $10,000 per mile.

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New Hudson River Bridge Opened at Albany, N. Y.

A new bridge across the Hudson River, between Albany and Rensselaer, N. Y., was formally opened to traffic on Jan. 23, 1933. It is believed that this bridge, which is of the vertical lift type, has the heaviest movable span of its kind in the world. The movable span is 341 ft. long and weighs 2,700 tons. It is raised and lowered by two General Electric 250 h.p., 410 r.p.m. shunt-wound motors, although either one of these motors is capable of performing the task alone. The electrical equipment for the bridge was designed and built by the General Electric Co.

Control for the bridge is located in a switch house mounted above the center of the movable span, where the operator has an unobstructed view of both bridge and river. As a safety precaution, the entire system is interlocked so that the span can not be raised until the gates at both ends are in position and the traffic signals for motorists have automatically turned red. When the span reaches the top of the towers, a signal to proceed is flashed to boats on the river. With the span raised to its maxmium height, river craft will have a clearance of 135 ft.

Determining Yield of Concrete *By Density Method*

By W. S. Foster

Student, Iowa State College, Ames, Iowa

REALIZING the need for a more accurate manner of yield-determination, the Iowa Highway Commission recently adopted a "density" method analysis for this purpose. Details of this method have been developed during the past two years under the supervision of Mark Morris, chief of the Iowa Highway Commission Research Laboratories.

Heretofore this highway commission had depended on the rather inaccurate method of cross-sectioning the grade before and after paving to determine the yield. Some of their engineers, in making this test, set stakes with known elevations on each side of the road, pulled a string taut between these stakes, and measured the cross-section from the top of the string. Others used a level and made their measurements with it.

Twelve-inch Hemisphere in the Subgrade Waiting to Be Filled with Concrete from the Mixer

This method obviously was unreliable. Some tests showed slabs with unreasonable porosity. Others showed concrete with a negative quantity of air-voids. The errors were as obvious as the manner in which they were made. The fact that set and unset concrete differ in volume by approximately one per cent introduces almost a justifiable reason for change in itself. Coupled with it are the errors bound to arise from faulty measuring, differences in subgrade, and accidents that may happen to the stakes set along the road.

The manner of making the test by use of the density method has been developed after careful correlation of several methods with the results obtained from cross-sectioning. At present the practice is to take a hemispherical cast-iron bowl, preferably about 12 inches in diameter, place it in the sub-grade, and allow paving operations to continue over it, filling the bowl with concrete as it appears in the slab. When the finishers have completed their operations on the section of the slab where the bowl is buried, the operator removes the bowl and carefully strikes off the top to an even surface, doing this striking with either a section of plate-glass or a flat steel bar. Following this he weighs it. Usually the results of 15 such samples taken at intervals of 20 feet suffice to make the test.

Easily the most important part of the entire operation is the striking off of the top of the hemisphere. Inasmuch as one weighs these samples to the nearest hundredth of a pound, it would not take an undue amount of carelessness to throw these readings off.

For the calculations, one must know the specific gravities of the materials and the amount of water used. One may best demonstrate this method of calculation by taking an actual project run and comparing it with the cross-section method run with it.

On the project under consideration the contractor used his materials in the following manner:

Material	Sp. gr.	Proportion	Wt. of material per batch of concrete lb.
Cement	3.14	1.000	643
Sand	2.65	1.988	1,278
Limestone	2.58	2.842	1,827

The average of 15 tests showed a weight per cubic foot of the concrete to be 148.69 pounds. This weight per cubic foot they determined by the relation between the net weight of the sample and the volume of the bowl used. The average amount of water per batch was 283.28 pounds giving a water-cement ratio of 0.4406, as shown by the following calculation:

$$\frac{283.28}{643} = 0.4406.$$

The Hemisphere Full of Freshly-Laid Concrete Is Removed Immediately After Finishing Operations: Note the Finishing Machine in the Background

Knowing this, computations for the volume of each material in the cubic foot follow.

Material	Proportion	Wt. per cubic foot	Cubic feet of material per cubic foot of concrete, absolute volume
Water	0.4406	10.45	0.1675
Cement	1.0000	23.71	0.1210
Sand	1.988	47.14	0.2851
Limestone	2.842	67.38	0.4185
	6.271	148.68	0.9921

Sample calculation—

Let w = weight of water per cubic foot of material.
W = total weight per cubic foot of all materials per cubic foot of concrete.
p = proportion for that material.
P = sum of all proportions.

Then—

$$\frac{w}{W} \text{ as } \frac{p}{P}$$

Calculation for the water—

$$\frac{w}{148.68} \text{ as } \frac{0.4406}{6.271}$$

w = 10.45 lb. per cu. ft. of concrete

$$\text{Absolute volume} = \frac{\text{Wt. of material}}{(\text{Sp. gr.})\ (\text{wt. per cu. ft. water})}$$

$$= \frac{10.45}{(1)\ (62.4)}$$

$$= 0.1675 \text{ cubic feet of water per cubic foot of concrete.}$$

From this analysis it is obvious that the difference between 1.000 cubic foot and the 0.9921 cubic feet obtained by absolute volume is air-voids; in other words, the concrete is 0.0079 or 0.79 per cent air per unit volume. It is interesting to notice that on this same project a string-lining test run in conjunction with it gave a result of —0.89 per cent air per unit volume, an obvious impossibility.

The engineer may find the yield the concrete is giving by using the data already in hand. Perhaps the easiest manner of expressing this yield is in cubic feet per hundred pounds of cement. The Iowa Highway Commission uses this method because on jobs in that state specifications require the use of bulk cement. It would be just as easy, however, to express this yield in cubic feet per bag of cement or any other unit of cement one uses on his particular project.

This yield is readily determined by dividing 100 pounds or as many pounds of cement used in the desired unit by the amount of cement used to get a cubic foot. Thus:

$$\frac{100}{23.71} = 4.2194 \text{ cubic feet per 100 pounds of cement.}$$

The Operator Strikes Off the Top of the Hemisphere Using a Section of Plate Glass for This Purpose. The Portable Scale Used to Weigh the Sample Is Shown in the Background

In Iowa the mix referred to was designed to give a yield of 4.1991 cubic feet per 100 pounds of cement. To correct this error in yield their procedure was to take the difference between the two yield-units and multiply it by the number of hundred pounds of cement they used. This would give them the cubic feet of aggregate they were in error. By deducting this from their batch-weights, determining of course the weight of this volume of aggregate, they could make their corrections.

Example—

4.2194—actual yield in cu. ft. per 100 lb. cement
4.1991—estimated yield in cu. ft. per 100 lb. cement

0.0203—error yield in cu. ft. per 100 lb. cement

There were 6.43 hundred pounds of cement used per batch, therefore the volume of error

$$= (6.43)\ (0.0203)$$
$$= 0.131 \text{ cu. ft. of aggregate.}$$

Cost of Giving Jobs Is Less Than Doles

The high cost of supporting people in idleness, rather than providing them with work, is set forth in a statement issued here through the auspices of the National Committee for Trade Recovery by John P. Hogan, a leader of the American Society of Civil Engineers.

"To illustrate the economy of unemployment relief by public works rather than by taxation to pay a dole, assume a public works construction program amounting to three billion dollars," Mr. Hogan said. "This involves a charge for interest and amortization of about $150,000,000 a year. It is estimated that such a program would give employment to between 1,500,000 and 2,000,000 workers per year, distributed between construction work and the many industries that serve construction.

"To support these same workers in idleness would cost the community between $750,000,000 and a billion dollars a year, as compared to interest charges of $150,000,000 on a public works program.

"Money expended in doles or direct relief contributes little to the stimulation of trade, whereas money spent in public works stimulates business not only in the community itself but throughout the material and transportation industries. If the money for a dole is to come out of taxes, as it properly should, since it is ruinous to borrow money to give away, the present burden on the taxpayer would be actually relieved through a public works program because the taxpayer will only have to bear the interest charge on the monies expended.

"The majority of the unemployed in this country do not want a dole—they want work. An attempt recently in one of our large cities to transfer unemployed from work relief to the dole met with such protest that it had to be abandoned. Those employed on work relief or public works retain their social status and their self-respect, while those on direct relief or the dole tend to become demoralized and discouraged.

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Highways in Canada.—The area of Canada is 3,684,723 square miles, and the 1931 population was approximately 3,934,000 (about 50 per cent rural). In 1930 the railways totaled about 42,000 miles. Motor vehicle registration on Jan. 1, 1932, was 1,186,960, of which 1,024,139 were passenger cars, 1,729 busses and 161,092 trucks. The highway mileage for 1931 was reported at 394,373 miles, according to Foreign Highway News. Type classifications were as follows: Unimproved earth, 158,640 miles; sand clay or graveled earth, 226,583 miles; macadam, 6,437 miles; concrete, 2,696 miles; and all others, 17 miles. In 1931 surfaced highways increased 5,390 miles over the previous year.

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Highway Work in France.—The proposed French budget for 1933, together with the highway section of the projected National Equipment Program, according to Foreign Highway News, calls for expenditures of about $97,200,000 for the repair, construction and maintenance of French highways for the next fiscal year. In comparison with the French national budget for 1932 (drawn up on a 9 months' basis, plus a pro rata addition for 3 months) the sums appropriated for that year for these purposes amounted to about $92,000,000.

EDITORIALS

An Alternative to Diversion of Gasoline Taxes for Unemployment Relief

The "real wages" of the average American in 1929 were nearly five times what they were in 1840. Since men in 1840 had the necessities of life, nearly all of the 400 per cent increase in "real wages" must be spent for what would have been called luxuries in 1840. Among the most prominent of present luxuries is the automobile. As shown in another article, more than 20 billions of dollars are invested in American motor-vehicles, garages and filling stations. Almost an equal sum is invested in the roads and streets that they use. Hence about 10 per cent of the entire wealth of the American people is invested in highways and motor-vehicles. Calling roads and road vehicles the highway industry, it is evident that no injury can be inflicted upon this vast industry without having a profound effect upon all other industries in America.

Certain state legislatures have passed laws that injure the highway industry. We refer particularly to diversions of gasoline taxes to other than highway uses. The argument in favor of such diversion usually has been that highway maintenance and improvement are luxuries that can be dispensed with in hard times. However, the same argument would apply to four-fifths of all the expenditures of the American people, for, as just shown, the entire increase in "real wages" since 1840 is spent for luxuries.

It has long been evident to economists that all that has prevented a steady increase in unemployment during the past century has been an increase in the consumption of luxuries. Hence any act that reduces the general consumption of luxuries is equivalent to increasing unemployment, and is therefore suicidal.

The diversion of gasoline taxes from road maintenance on the ground that good roads are a luxury, is equivalent to discharging men engaged in highway maintenance. It so happens that good roads have become an economic necessity to those that use them, for a poor road increases wear and tear, gasoline consumption, etc. But the point that we are now stressing is that Americans not only do not wish to dispense with their luxuries but that they would be foolish to do so.

Judging by the standards of a century ago, four-fifths of all Americans engaged in gainful occupations are producers of luxuries. To single out any particular class of these workers and declare that their employment is no longer necessary is without justification. The public by its purchases and patronage has decided what luxuries it wants. No legislator or group of legislators can know what the public wants quite as well as the public itself knows. When the public bought 26 million motor-vehicles and taxed itself to improve and maintain roads for those vehicles, presumably it knew what it wanted. Yet some state legislators have been virtually telling the public that it was mistaken, for they have diverted gasoline taxes to uses that the public has never sanctioned; and coincidently have increased the ranks of the unemployed by scores of thousands.

There are several ways by which diversions of gasoline taxes may be avoided by states that are seeking funds for unemployment relief. But the most feasible way, and the fairest to all, is the issuance of bonds, the interest and the amortization of which will be provided for by a general sales tax. Bonds based on gasoline taxes have proved to be satisfactory both to the public and to the investor. Extend the principle by issuing bonds based on a general sales tax, and the present emergency would be greatly relieved without adding to the ranks of the unemployed.

An abundance of money and credit is available for such bond issues. By awakening this dormant cash and credit, the velocity of money circulation will be increased, and a return to prosperity will be hastened. Coincidently the normal amount of expenditures for public works should be made. The public would thus set the example that it is loudly calling upon other employers to set, namely, a return to payroll normalcy as speedily as possible.

The Future of Wages and Prices

IN 1926 the U. S. Bureau of Labor adopted the wholesale price index as a standard, calling it 100, and abandoned the average price level of 1913 as the standard. This was done because it was believed that it would be a great many years before a return to the 1913 level would occur. Prof. Irving Fisher and many other economists were of that opinion. But in December, 1932, the wholesale price index was 63 as compared with 68 in 1913.

The world war ended in November, 1918, and 14 years later the wholesale price index was the same as the prewar index of 1914. Our civil war ended in 1865, and 14 years later the price index was the same as the prewar index of 1861. So in both cases it took 14 years after the end of the war to return to the prewar price level.

After the civil war prices declined slowly for 31 years, reaching their lowest point in 1896. Then they rose slowly until 1914 and thereafter rose rapidly until 1920. A very important economic question confronts us, namely, whether commodity prices will continue to decline for many years as they did after the civil war. The editor's belief is that there will be a rebound from the present level, because per capita money is even greater than in 1929 when the recent precipitous decline in prices began. The recent violent decline in wages and prices is quantitatively accounted for by the reduction in the velocity of circulation of currency.

For 90 years the average wage in America has been nearly proportional to the per capita "stock of money" and to the velocity of circulation.

The commodity price index has been directly proportional to the average wage and inversely proportional to the per capita output of commodities.

These two economic laws lead us to infer that when business conditions become normal, there will be a rebound in wages and commodity prices to a level not far different from that of four years ago; for the factor that affects the long time trend of wages is per capita "stock of money," and that has not decreased. At present per capita money is greater than in 1929, because withdrawals of currency from banks by frightened depositors has been accompanied by a corresponding increase in paper money in the form of federal reserve notes.

The present abnormal factor is the velocity of currency circulation, which is more than one-third below normal. That factor has always returned to normal, and never before has it been subnormal for longer than five years.

Auroras That Accompany Certain Earthquakes

JAPANESE seismologists have been studying the peculiar luminescence that frequently appears in the upper air prior to and during a great earthquake. Dr. Free's "Week's Science" says: "No way is known in which such lights could be created by the shock or by the preliminary earth stresses from which the shock results. * * * It seems that the reality of some kind of luminosity in the sky in the neighborhood of earthquakes must be accepted, although neither Mr. Musaya (the seismologist) nor any other man has been able to suggest a plausible theory of how these lights are caused. Perhaps some electrical disturbance of the upper air precedes or accompanies the earthquake and causes lights like the aurora."

Dr. Free's hypothesis is probably correct, and incidentally it fits in with an earthquake hypothesis published by the writer in the October, 1928, issue of "Engineering and Contracting." It was there pointed out that electrons escaping from the earth probably cause spirally ascending currents of air, thus tending to produce rainfall. Electrons are known to act as nuclei for raindrops. Faraday's principle of magnetic rotation insures a rotary motion of ascending or descending electrons in the earth's magnetic field. This is the writer's theory of whirls in the air. A little consideration shows that the same theory is applicable to any fluid, such as molten rock, through which electrons are flowing upward. Heat liberates electrons, but it also liberates protons, and the two must become separated before magnetic rotation occurs in a fluid. The separation is the result of the magnetic repulsion between electrons and protons moving in the same direction, as they do because of the earth's axial rotation.

Spirally ascending electrons in molten rock tend to lift the rock, just as spirally ascending electrons in the air lift the air. Perceptible crustal tilting should therefore precede a great earthquake, and Japanese sesismologists some time ago found that this occurs. Now they have also found auroral luminescence, which is precisely what should occur under favorable conditions; for after the electrons leave earth in their upward flight they encounter such electron-shells as the "Kennelly-Heaviside layers," one of which is 62 miles above the earth and the other twice that high. Stoermer has found that most of the auroras occur at an elevation of about 62 miles. The writer has inferred that auroras exist in the Kennelly-Heaviside as a result of electron-whirls generated by ascending currents of electrons. It follows that if earthquakes are molten cyclones that cause crustal uplifts, then illumination of an auroral nature should occasionally occur at the time and in the region of great quakes.

Incidentally this theory also explains the fact that there are several earthquake cycles that correspond with rainfall cycles and with auroral frequency cycles. Moreover, it shows why ice-ages were accompanied by great crustal uplifts and outflow of lava. As stated in previous articles, there is excellent evidence that the topography of this globe is mainly the result of molten cyclones.

In our next issue evidence will be given to show that the earth is encased by many pairs of electron-shells whose axes gyrate periodically and in harmony. The angle of such an axis relative to the ecliptic and to the sun determines the amount of displacement by its magnetic action upon the sun. This displacement determines the flow of electrons from the earth into the air, and vice versa. These electron currents cause cyclonic and anti-cyclonic whirls in air, ocean and molten interior.

Since the above was written, Dr. Harry B. Maris has published his discovery of an ionized shell about 1,300 miles high above Fairbanks, Alaska. He thinks it is the Kennelly-Heaviside layer that is distorted near the poles. Bird found that the Kennelly-Heaviside layer is higher in the antarctic region than elsewhere, but only moderately so. Hence there is slight probability of any such elevation of this shell in the arctic region as Dr. Maris infers. On the other hand, there is evidence of several distinct electron-shells. The cloud layers seem to indicate several such shells in the lower atmosphere. Stoermer's radio echoes indicate other electron-shells of vast diameter.

May it not be that Picard is right in believing that the cosmic rays are not cosmic, but come from the upper air? Compton regards them as being high speed electrons. If so, are they not electrons shot out of electron-shells?

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Economic Illiterates

OUR bonded indebtedness, both public and private, exceeded half the value of all the physical property in America in 1929. When bank loans are added to bonds, the total in 1929 was 208 billion dollars. One economist estimates that our total indebtedness of all kinds was about 300 billions!

It is safe to say that all the physical property in America could not be sold, at present market prices, for 300 billions. Do not these facts give the answer to the question, What caused this depression?

In 1880 the "individual bank deposits" were $43 per capita. In 1929 they were $438 per capita. Since bank loans approximate the same amounts as individual bank deposits, it follows that in 1929 our per capita indebtedness to banks had become tenfold what it was 50 years earlier. During the same period our total "stock of money" rose from $64 to $190, or threefold; and average wage rates increased in about the same proportion. Hence it cannot be argued that increased income warranted the increased borrowing at the banks. Incidentally these figures disclose that average wages follow the per capita money trend and not the per capita bank deposit trend.

Coupled with this borrowing mania which bankers encouraged, there was inordinate stock market and real estate speculation. But since this speculation was itself made possible only by the use of credit, we come back to excessive borrowing as the fundamental cause of the present debacle.

Prior to the collapse of credit, in 1929, most bankers seem to have thought that the federal reserve system provided adequate protection against such a collapse. Now some of them tell us that they had never placed much confidence in that system. If so, why were they not more outspoken before the collapse?

Technocrats tell us that it is machinery that has brought all this distress. While we grant that "mechanism" has put many of us on the dole, it is not the inventors who have brought this to pass, but the bankers, financiers and promoters who have encouraged the excessive use of that "economic mechanism" called credit.. Yet let us not blame them more than we blame ourselves. We have been economic illiterates, the world over.

H. P. Gillette

County and Township Roads

A Section Devoted to the Interests of Those Responsible for Secondary Road Improvement

The Farmers' Interest in *Adequate Highways*

By CHESTER H. GRAY
Washington Representative, American Farm Bureau Federation.

TRANSPORTATION is an age-old problem for mankind. We have an authoritative statement from Lord Bacon's Essays that it is one of three main features in human affairs which have to do with a happy civilization. It has not ceased in 1933 to be a problem, both economic and social. The farmer is more almost than any other citizen interested in transportation matters. This is true because the farmer pays freight both ways—going out on his products and coming in on his supplies. Consequently, any development in regard to transportation, which contains a possibility of giving him either cheaper rates or better services, is seized upon actively, both by the individual farmer and by his organizations.

This accounts largely for the extreme interest in the last decade in expanding the highway program of the nation, and in correlating state, federal and county funds in the building of a national system which will reach as much as may be into every portion of our great nation. The activity of farmers relative to transportation matters in our nation is not a new one. It was they, more than anyone else, who advocated in the colonial period the building of canals which then offered cheap transportation and more efficient service in transporting persons and products from the farm lands to the markets, and particularly to the seacoast. Later, in the railway era, farmers were ready to vote bonds to permit grants of one sort or another, and to do whatever appeared necessary hastily to expand the railway mileage.

Years later, even before the advent of the present highway era, inland waterways came to have a great appeal to farmers, both within and without organizations. It was thought that for bulky and non-perishable commodities, such as many which are produced on the farms of our nation, waterways would be useful in bringing the seacoast nearer the great productive areas of our nation. The generation of farmers which supported the beginning of our present waterway development differed only from that farming generation which supported canals in that the present generation believes in building the channel in the stream rather than alongside it. Almost within the last decade the highway area, from a national point of view, came upon us suddenly. It had been growing in a most natural way from the localities such as towns and townships into a national enterprise. Finally, the gradually decreasing profit in American agriculture, part of which decrease was attributable to a high freight cost together with the invention of the automobile, quickly expanded our agricultural vision relative to highways from that which time immemorial has characterized them as being local trails into their present category of being intra and inter-state arteries of commerce.

Time was when the farmer not only was glad, but was proud, to vote bonds upon his neighborhood to build highways. At that time this was a logical procedure because the traffic was largely local. Weights were light; speed was slow; maintenance comparatively inexpensive; and original construction not as high as modern necessities and conveniences require. Furthermore, in that early stage of our highway development farmers looked upon a highway running through a township, built wholly as was the case in most instances at the bonded cost of contiguous, or near contiguous, property, as an improvement which would hasten the benefits ordinarily evident in the growing commonwealth and usually grouped together under a general term known as "unearned increment." So even though it cost some money to the local property to build the highways, such building was looked upon as an investment which would come back in an increased value upon the local farms.

Old Order Passes.—That time has passed. Farm land now seems to have not much capacity in years ahead to reap rewards from "unearned increments." We are in an economic era. The farmer dare not view transportation facilities or transportation systems as possibilities to return him something in the future. He must get his reutrn from them year by year. The farmer now must make a profit from an actual book-keeping point of view, or if he fails in doing so in a few years he is marginal, even though living on fertile acres; and in a short while thereafter is crowded out of the business. He cannot live and be happy, economically speaking, as did his forefathers who, though bonding themselves to build highways and for other purposes, emerged in good financial condition on account of civilization and society developing around them, thereby adding to their wealth.

Accordingly, the farmer of 1933 must view the transportation question from the point of view of dollars and cents, dollars and cents either brought or saved to him and not dollars and cents expended in building a highway system for the nation as a whole to use. This sit-

uation has brought us to the present highway era. First, state aid came along and helped develop the highways by taking some of the burden off local property. It was the next and logical step for federal aid to enter the highway picture. This was done, as is well known, about 15 years ago. It was done timorously and with a small initial appropriation. It has expanded until federal aid for highways has come to be a recognized function of the federal government, supported both by farmers and city residents. It is not likely that the national aspect of highway development will soon be removed. More evidently the development will be that along with many another federal contribution for the purpose of promoting general welfare, appropriations will be made for highway building. Temporary periods may be met, like the present, wherein as many millions of dollars are available as at peak periods, but the principle of federal, state and county highway building, cooperatively, is so well established that it neither will be, nor should be, eliminated.

There is some thought that our final national objective in highway building will soon be reached—that is, that the federal-state highway system, the so-called 7 per cent mileage nearing completion in several states, will, when fully completed, absolve all responsibility either for maintenance or additions on the part of the federal government. There is a much more popular thought, however, that as the original primary system is completed or nears completion, additional mileage shall be added so that more and more the entire nation may be net-worked with highways.

In farm language these additions in many instances are referred to as farm-to-market roads.

It is perhaps too much of a vision to cultivate the idea that our hard surfaced permanent type roads by the expenditure of federal and state funds mostly, and by the elimination of bonded local funds, will ever reach out to every highway in the nation. It is not an extreme vision, however, to cultivate the thought that from the primary system now nearing completion many a lateral farm-to-market or secondary road can be constructed, reaching out through the smaller towns and villages and giving access to many a rural community which is now within reach of the primary system.

Farmers would rebel right now against the entire highway program of the nation if it were definitely announced that such program would soon terminate. It is a reasonably accurate statement to make that most farmers think the highway area has not yet reached them—speaking in relation to their own location in respect to a hard surfaced all-year-round highway; and in fact if we should stop now, this thought on the part of farmers would be too true. But we are not stopping. We may slow up a bit while the depression is upon us, but depression will stay longer upon us from our having slowed down in highway building.

Highway Expansion.—Some aspects of the possibilities to extend our highway system more and more out into the rural districts need consideration. On the one hand we find an intense, but not dominant, thought that federal funds should now mostly be used for widening, straightening and boulevarding the primary system. Popularly this thought is attributed to those who use buses and trucks, or as is popularly termed commercial vehicles. Practically, one may suspect, this development of public thought is more traceable to the desire of drivers of private automobiles, who want more speed; but whatever the source of the thought may be it is recognized that it has gained some recognition in the rebuilding program on our highways, with the evident result that the extension of mileage, whether for primary or secondary purposes, is not as possible as would otherwise be the case. It should be recognized, of course, by all that in certain areas where traffic is unduly heavy different types of highway are necessary than in what we refer to as the "wide open spaces." It should be recognized, however, that in the congested areas where more property and citizens reside, greater proportions of the cost of building the necessary four lane, or other similar types of highways, should be borne locally.

This development of public thought has led also to an agitation for, and some acquiescence in, the elimination of the limit per mile for use of federal funds. It is realized that in some of our western states, where distances are large and population sparse, it is an attractive proposition to have this federal mileage limit eliminated. It is recognized, too, that a great deal of the support for the elimination of this limit comes from the congested areas above spoken of, where it is desired to spend greater amounts of federal money on lesser extents measured in miles. This development is not diametrically, but is largely, opposed to the more prevalent thought that our highway funds should go more and more into extension of mileage rather than to become absorbed year after year in working over the mileage we already have. It is not meant to state that by the term "working over" is meant necessary maintenance and the preservation of safety to traffic on the highways. It is to be hoped that the conflict of ideas between those who advocate what one may term concentration of expenditures for federal highways, against those who advocate expansion of mileage in highways, will not come to a point where the issue must be fought out between two conflicting schools of thought. It would evidently be much better to use the highway area in which we now live as a factor in spreading civilization and the economic results therefrom into as many portions of the nation as is financially possible, than to follow the course of too many civilizations gone before, which have adopted the plan of concentrating governmental expenditures where the benefits come to a few rather than to many.

Competition in Transportation.—As a result of a steady growth of highway mileage and the remarkable facility which the people of our nation have evidenced in using that mileage in the form of motor vehicles both for pleasure and profit, there has come to be a clash of interests between the older methods of transportation and the newer systems, such as waterways and highways, notably the latter. We are going through a period now which in economic aspects is identic to that which occurred when railways displaced canals, the Conestago wagon route, the prairie schooners and the pony-express. In that time those who had their investments in the older methods of transportation raised a cry that the newer method of transportation—the railroad—should not be encouraged by government, either federal or state, because such encouragement would devaluate the investments in the older methods of transportation. The result of that controversy was the same as many another one in which the people of our nation have participated and have experienced.

The people took the newer method of transportation, subsidized it in various ways, and indeed it did displace almost absolutely, but not instantaneously, the then older methods of transportation. Decades went by; what was once a new method of transportation has come to be in our time the old method of transportation. Devices for getting people and products from place to place, both for pleasure and profit, not thought of a half

century ago, such as our present waterways and highways, not to mention airways, have come into vogue. The conflict has gone on between the old and the new.

The question uppermost in many minds is, will the new displace the old? Superficially, the answer would be yes. Analytically, the answer does not need to be of that character. The highway system, just as every other method of transportation of national consequence which we have had in America, may be said to have secured at least a part of its development through subsidy methods, but since this is true of all of them, and is true of the newest method of transportation we have, airways, we may take it as having been, and continuing to be, a national policy to secure transportation facilities in part at least by subsidizing them.

The clamor of the present time on account of this conflict is of the acutest interest to the farmer. He wants to get his products to market at the least cost possible with service incident to that cost a prominent factor. He willingly will not tolerate restrictions on the newer benefits reaching out to him and to his products. The motor vehicle, he considers to be a necessity, not a luxury, and as much a part of the modern transportation system, both for persons and products, as is is the locomotive on a steam train, or as is the highway itself. *Consequently, efforts of restrictive and undue nature, either federal or state, in relation to laws and regulations which will so obstruct the use of the motor vehicle as to prevent the average citizen owning or using it, and operate to make nearly useless our vast and increasing highway mileage, will be resisted by him at every step.*

Restrictive Taxing.—The farmer in the United States realizes that our citizens, town and country, are most favored of all in the world in the use of the motor vehicle. He looks abroad and he finds citizens of foreign nations looking longingly at the United States in regard to its motor vehicle development, but not able for themselves to enjoy that modern development either for pleasure or profit as we do. A large contributing cause abroad is not so much the first cost of the motor vehicle as its operating maintenance. This operating maintenance abroad is not in most instances attributable to a voluntary effort on the part of governments to make motor vehicles non-competitive to their railroads, but as attributable to a multitude of costs and charges from most of which governmental funds are derived to balance what ordinarily are depleted governmental budgets. The result of it is that the foreigner, too, often cannot afford either to own or use a motor vehicle so that the per capita use of the family car, saying nothing for the moment about commercial vehicles, is out of proportion to that which we know exists in the United States.

The government at Washington, and at many of our state capitols, is now finding themselves in situations not dissimilar to foreign governments in relation to budgetary matters. So we are gradually Europeanizing the American automobile by making its cost of operation so high that the average citizen is retiring from its use, especially the family car. Gas taxes are being exploited to undue heights, and are now beginning to be deferred for other uses than constructing and maintaining highways. The federal government has stepped into the gas tax field, and no immediate prospect of retirement therefrom is in sight.

Fees, costs and charges of many forms are so common in our states as to constitute virtually a web of financial entanglements, into which many of our citizens of modest income dare not become entwined. The consequence of this is that even in times of prosperity, and much more in times of depression, the family car is a diminishing prospect in the home life in the United States. This is more particularly true in regard to farmers than to most other groups, as the average annual net income of the farmer is known by current statistics available for the past decade to be less than for many other people in different walks of life.

A contributing cause of this situation is the conflict between the new and the old methods of transportation. Seemingly, it is a fight to the death, but actually it will likely prove to be no such thing, although it did once, in our comparatively short American civilization, so prove to be.

Allow Competition.—The farmer is willing and anxious that all methods of transportation which we now have available to us—the highways with the motor vehicles, the railways, the waterways and the airways—be so conducted that each will survive a competitor to the other, but not be consolidated one into the other. This thought in agriculture was spoken most definitely in a resolution of the American Farm Bureau Federation, entitled Truck and Bus Regulation, adopted in December, 1930. This resolution reads:

"It is evident that federal regulation of motor buses and trucks which qualify as common carriers and do interstate business will soon be enacted. The traffic of buses and trucks on our publicly built highways has developed to such proportions that public interest and public safety require regulatory legislation. The length, width, weight, speed, rates and services of these modern commercial vehicles all need to be subject to control by a proper federal law. However, legislation and regulations of the federal government should not be so stringent as to remove the competitive features between the older and the newer forms of transportation, which the present system is now thought to secure. No single federal agency should be permitted such latitude of administrative and regulatory control as to place all transportation on the same basis as to rates and services. Agriculture needs to use the newer and more economic method of transporting its products to the railroads, and to the markets both local and terminal, and to the rapidly developing river systems of our country"

It will be seen from this statement that all forms of transportation are desired to be retained, but that competition as to rates and services must not be eliminated by law or regulatory influences. A natural conclusion from this statement is that farmers look askance at efforts to lodge in one regulatory body controlling influence as to rates and services over highways, railways, airways and waterways. It may not be logical, but is nevertheless a presumptive conclusion, that such system of regulation almost inevitably would tend to secure for us, if not immediately then eventually, non-competitive operation of the highway systems of our nation.

But the farmer is not an advocate particularly of one system of transportation, old or new, compared to the other. He believes in being fair to all. The railroads, the oldest of our present methods of transportation, have their rights both as relates to laws and regulation. Undoubtedly this should continue to be true also of highways, railways and waterways. This continuation is stated in the resolution entitled "Transportation" adopted by the American Farm Bureau Federation at its 14th annual convention in December, 1932, as follows:

"Agriculture needs and demands the greatest possible benefits both in rates and services from all forms of transportation for persons, and products, whether for profit or pleasure. Transportation facilities such as motor vehicles supply must not be allowed by state or national laws and regulations to be made non-competitive to whatever other methods of transportation our nation enjoys. The motor vehicle is a necessity to agriculture and cannot be classed as a luxury; accordingly it must not be crowded off our highways by prohibitive limitations, regulations and charges. On

the other hand, railroads being a well established method of transportation, should be allowed opportunity to meet competition in transporting persons and products. Consolidation of railroads should not only be permitted but encouraged when done in the interest of the public welfare; much greater freedom from state and federal restriction in offering round-trip, special, and excursion passenger rates should be allowed; direct ownership and operation without the necessity of using subsidiary corporations of bus and truck lines as feeders to the main trunk line should be permitted, by both state and federal laws and regulations; and the right of pick-up and delivery in less than carload lots should be granted the railroads if not done below the actual cost of such service. We reaffirm the resolution entitled 'Bus and Truck Regulation' adopted in 1930."

It will be seen that from the farmer point of view, in relation to adequate highways, he approaches it almost, but not wholly, from the economic angle. He wants transportation as brought to him by the highways to be a factor in enabling him to get at least a bit more profit out of a business which in recent years has been characterized by too much lack of profit, whether or not the farmer himself were efficient or inefficient.

As time goes on highways will undoubtedly fit into the economic fabric of American agriculture more than they do at the present time, and infinitely more than they did decades ago, provided we keep them on an expended mileage basis and not prevent their use by exorbitant rates and charges, or ridiculous laws and regulations.

Acknowledgment.—This article was presented as a paper before the Highway and Building Congress.

Motor Vehicle Industry in 1932

Preliminary facts and figures relating to the motor vehicle industry in 1932, compiled by Alfred Reeves, vice president, National Automobile Chamber of Commerce, follows:

PRODUCTION AND VALUE

Cars and trucks produced in U. S. and Canada..	1,436,000
Passenger cars	1,198,500
Motor trucks	237,500
Production of closed cars	1,115,000
Per cent closed cars	93%
Wholesale value of cars	$646,500,000
Wholesale value of trucks	$138,000,000
Wholesale value of cars and trucks combined...	$784,500,000
Average retail price of cars	$720
Average retail price of trucks	$776
Tire shipments	41,150,000
Wholesale value of parts and accessories for replacements, and service equipment	$250,000,000
Wholesale value of rubber tires for replacement.	$275,000,000
Motor vehicles, accessories, service equipment and replacements of parts and tires	$1,309,500,000
Gasoline consumption by motor vehicle, retail value including taxes	$2,382,000,000
Lubricating oil used, retail value	$359,100,000

REGISTRATION

Motor vehicles registered in U. S. (from state reports)	24,276,000
Motor cars	21,045,000
Motor trucks	3,231,000
World registration of motor vehicles	33,026,000
Percent of world's automobiles in U. S	73%
Passenger cars on farms	4,100,000
Motor trucks on farms	880,000
Motor vehicles on farms	4,980,000
Miles of surfaced highways	868,000
Total miles of highways in U. S	3,055,000
Highway and street expenditures	$1,900,000,000
Persons employed in motor vehicle and allied lines	3,700,000

TAXES

Total motor vehicle user taxes	$1,085,000,000
Gasoline taxes, Federal, state and municipal....	$595,000,000
Service station value of gasoline, before taxes..	$1,787,500,000
Percent of gas tax to service station value, before taxes	33%
Percentage motor user taxes to all taxes from all sources Federal, state and local	12%

AUTOMOBILE'S RELATION TO OTHER BUSINESS

Automobile industry is the largest manufacturing industry based on value of finished products	
Automotive industry is the largest purchaser of gasoline, rubber, alloy steel and malleable iron, mohair, upholstery leather, lubricating oil, plate glass, nickel and lead.	
Number of carloads of automotive freight shipped over railroads in 1932	2,570,000
Rubber used by automobile industry	83%
Plate glass used by automobile industry	55%
Steel and iron used by automobile industry	17%
Lumber, hardwood, used by automobile industry	14%
Copper used by automobile industry	15%
Lead used by automobile industry	14%
Aluminum used by automobile industry	20%
Nickel used by automobile industry	26%
Tin used by automobile industry	12%
Zinc used by automobile industry	7%
Gasoline consumption by motor industry	85%
Gasoline used by motor vehicles (bbls. of 42 gal.)	320,000,000
Lubricants used by motor vehicles ((bbls.)	9,500,000
Lubricants, per cent used by motor vehicles	57%
Crude rubber used by motor industry, 1932 (lbs.)	589,000,000
Cotton fabric used in tires, 1932 (lbs.)	165,000,000

MOTOR TRUCKS

Motor trucks in use	3,231,000
Number of trucks owned by farmers (27% of all trucks)	880,000
Motor truck owners	2,500,000
Common carriers, per cent of all trucks (Interstate, 1.05%; Intra-state, 4.45%)	5½%
Contract carriers, per cent of all trucks	8.7%
Privately owned and operated trucks	85.8%
Total motor truck taxes	$290,000,000
Trucks represent 13% of all motor vehicles, and pay 27% of all motor taxes	
Railroads using trucks as part of shipping service	100
Motor trucks used by steam railroads	12,000
Motor trucks used by Railway Express Agency.	9,247

MOTOR BUSES

Motor buses in use	99,000
Number of revenue carrier buses	45,000
Consolidated schools using motor transportation..	16,700
Buses used by consolidated schools	52,000
Buses used by street railways	12,000
Buses used by steam railroads	4,800
Street railways using motor buses	245
Steam railroads using motor buses	80

FOREIGN SALES

Number of American motor vehicles sold outside U. S. (U. S. exports and output in U. S. owned Canadian plants)	182,000
Per cent decrease in foreign sales under 1931...	44%
Per cent of production sold outside U. S	13%
Value of motor vehicles, parts and tires exported from U. S. and Canada	$93,125,000

MOTOR VEHICLE RETAIL BUSINESS IN U. S.

Total car and truck dealers	39,871
Garages, service stations and repair shops	97,721
Supply stores	69,179
Total retail outlets, duplications eliminated	103,605
Gasoline filling stations	350,000

Double Parking Causes Traffic Congestion.—One of the chief causes of traffic congestion on our city streets is the all too frequent practice of double parking indulged in by inconsiderate or thoughtless motorists, according to Dr. Miller McClintock, director of the Albert Russel Erskine Traffic Bureau of Harvard University. On narrow or crowded streets, double parking reduces even further the value of an already inadequate traffic facility, he points out, while even on wide pavements the practice creates the effect of a bottle neck to retard the normal traffic flow. One car parked out of line will often result in a disturbed traffic condition for several blocks on either side of the obstruction, he says.

BEFORE

Not a very inviting roadway was Route 327, west of Falmouth, Virginia

NEITHER

Was this same road particularly pleasant driving east from Berea P. O. after a Fall rain

AFTER

Not a bad driving surface now on the Falmouth road

NOR

On the Berea P. O. road after a low-cost surface treatment job had been completed

The County Engineer and County Leadership

The Importance of Technical Direction of County Highway Operations

By J. W. Mavity

Chairman, Public Relations Committee, American Road Builders' Association

During this period of economic stress, when Taxpayers' Leagues are agitating tax reduction beyond all economical justification, the engineer is the first to suffer. I have no quarrel with Tax Leagues, and believe they could accomplish some good, if they would stick to that for which they claim to be organized. If they would cooperate with officers in office, in working out plans for curtailment of expenses, without interfering with efficiency; and if they would deal with facts instead of hysterical propaganda that taxes must be cut regardless of consequences; if they would analyze the proposition by careful and proper study, and determine where economy could be effected, the engineer would not suffer, but, no doubt, would be called upon to make these analyses for them, as they are usually lacking in leadership for making studies of this nature.

The public does not recognize the service that the engineer is rendering, either in the years of plenty or in the years of depression. Consequently, his salary is the first to be cut, and his organization is badly crippled, or entirely eliminated. In many instances, the engineer is replaced by some cheap politician who is not a professional man, and who has no knowledge of economical construction and maintenance of county road work. This condition is more prevalent in agricultural states than in industrial sections, where sound road-building principles have been established over a longer period of time.

The Public Relations Committee of the County Officials' Division, A. R. B. A., desires to promote better understanding between the public and the official in charge of county work, by giving publicity to information showing the value of the service of an engineer in public work, not only as a designer, but as one qualified to efficiently cope with the economic problem which now confronts the county. That his training and experience qualify him as an important factor in inaugurating sane principles and procedures in working out a solution of our modern governmental needs is fully recognized.

Road Building Engineering Problem.—Road building an maintenance is an engineering problem. The days of the horse and buggy are gone, and we are now confronted with an entirely different condition in road building. No longer can the building of roads be placed in the hands of men who know nothing of present day requirements. With present methods of transportation, attention must be given to location, grades, road materials, and their economic utilization; the character and amount of traffic, and a thousand and one things that enter into modern economical construction. The ordinary man or the politician know nothing of these things, because they have not made a study of them.

The engineer, on the other hand, has made a thorough study of all of these things. It is his life's work. He has spent years preparing himself for this work. He also keeps in touch with the best work elsewhere, and mtaintains an analytical attitude of mind, which is characteristic of an engineer. He is qualified to give you the most economical design for roads, and all the structures involved. He is qualified to give you a detailed estimate of the cost of the road. He is qualified to superintend the construction of the road, and assure you of value received for every dollar spent. He is qualified to furnish you with the correct and most economical maintenance for every type of road you may have. I emphasize the statement that road building is an engineering problem—the design, the construction, and the maintenance. Then, it follows that the engineer should be in charge of these operations. Never in our history has it been more important than now that our county road commissioners select a competent engineer as the executive officer—the operating head of the organization in charge of all road work.

In some sections of the country it seems like a difficult job to educate the public to the necessity of an engineer. People do not realize the saving that can be made by having competent men in charge. Many ranchers and farmers think that they are very competent engineers, and that election to office qualifies them as experts along almost any line.

Unemployment creates hard times for the farmers and merchants, and some of these seek political jobs *for what they can get out of them, and not for what they can put into them.* Many of them believe that the engineers are very greatly overpaid, and that a \$3.00 or \$4.00 a day man can render just as good service as a man who has prepared himself, and devoted years to this line of work. The sad part of it is that some counties employ some of these so-called engineers under the guise of tax reduction. These men are not technically trained, and are most expensive to the county in the long run. They know nothing of engineering principles. They know nothing of buying, and do not understand economics. As an instance, one such so-called engineer in a certain county bought a carload of material, not because the county needed it, but in order to be a good fellow with the salesman. Another incident: The county did away with the service of the engineer to satisfy the demand for lower taxes; then the three county commissioners set up repair shops in each of the three county commissioners' districts, and three separate organizations to handle the road work of the county; calling it economy. In another instance a county was temporarily without the services of an engineer. The county com-

missioners were in the market for certain material, and were dealing with a salesman who had quoted them prices on this material. The county engineer was employed before the deal was consummated, and the salesman immediately reduced his price one-third less than the figure quoted to the commissioners. A competent engineer knows costs and prices, and the salesmen know that he knows.

During the past two years some pretty serious situations have developed in some of the counties on account of over-financing highways, but none of these have occurred where the management was vested in a competent county engineer. I could cite cases by the hundreds, where, by the wise counsel and leadership of the engineer, counties have carried on sane programs of construction and maintenance for the past year, instead of being stampeded into tax reduction beyond all economical justification, as has resulted in many instances where this leadership was lacking. The value of technical direction has been demonstrated beyond any question of a doubt by the counties that have been outstanding in carrying on unemployment relief measures during the past two years.

Publicize Work.—I sometimes think that we, as engineers, are too modest in that we do not give publicity to the things that we are doing, but stand back and expect someone else to do it for us. We have so closely confined our attention to the details of our work that we failed to realize that the public is not familiar with these details, and it is up to us to acquaint the public with the things that we are doing. Quoting from an address entitled "The Engineer in Service of the Public" by Dean M. E. Cooley, of Michigan University:

"The work which is now, and in the future, must be the engineer's, if the public is to be served most effectively, cannot be done at all without the support of his neighbor in other walks of life. To win his support, he must make his neighbor understand. Thus the engineer must become a teacher, an apostle, ir you like, to preach the gospel of understanding to those who do not now realize the condition of things. . . .

"It behooves us, then, as engineers, to so regulate our conduct that the people will have confidence in us. The engineer's capital is his reputation. He must not depreciate or destroy it. He cannot afford that for his own sake, still less for his country's sake. He must stand ready to serve the people at this, a critical stage in our history as a nation, with a loyalty commanding the respect and confidence of everyone. To do this most effectively he must in addition to whatever specialty he may have in mind to devote himself, rise above it and view his profession of engineering in a broader aspect. He must recognize that his duty as a citizen is even more important than as a specialist, and stand ready at all times to aid in the solution of public questions for which his training has so well fitted him. . . .

"But your greatest work—a work in which there can be no failure for the earnest and sincere man—your greatest opportunity in life, will be found shoulder to shoulder with your fellow man doing the things good for us all. Thus, in serving yourself, you will serve your neighbor, your community, your state and your nation. You will be doing your part in helping to perpetuate the civilization of the entire world. . . .

"The one great obstacle to our welfare today is ignorance; ignorance of things based on engineering and economics. Engineering in its broadest sense may include the latter. In the service of the public, the engineer must as speedily as possible be made to understand that there are other things than mere material things to plan and execute. He should enlarge his horizon, look out upon the world, and try to comprehend the problems waiting to be solved. He should, as a first requisite acquire a knowledge of man."

Quoting from an address that I made before the Kansas Engineering Society a year ago: "Our profession has given much consideration to technical matters, but we should not become so absorbed in technical problems that we overlook another important branch of engineering, that of 'Human Engineering'—the relationship of man to man. . . .

"It is not enough that we make our contributions of technical knowledge, but we should take our places in our communities in aiding in the solution of problems that will benefit mankind. . . .

"We must bring the vision—our high ideals and the aspirations of our profession to a practical application in our individual contacts in our business, and community activities with our fellowman."

Leadership.—Thus, the engineer, by taking his place in all community activities has a wonderful opportunity of educating the public in the value of technical leadership. I wish to commend the county officials who have the vision to see the value of technical direction of county highway operations, and who have a competent engineer as their executive officer in charge of all highway work, and to urge them to retain such leadership during this critical period. To county officials who do not have this type of man in charge, I appeal to them to employ an efficient engineer as their operating head. The reduced opportunities in private industry have created a surplus of technical talent, which now is available to counties on a greater scale than ever before. The curtailed appropriations for county highway construction and maintenance make technical direction of county highway operations imperative. No other supervision can assure a maximum of accomplishment in road extension and preservation, with the limited funds available.

We are passing through a critical period, and county officials owe it to their counties to secure the best services available in order to do their part in stabilizing present business conditions. These engineers are rendering a great service in planning and promoting construction work in all of its branches as an aid to unemployment. The engineer has the ability to analyze. He can visualize the transformation of the idea into a living actuality. He can see it builded into the hopes and lives of people, so the engineer, with his trained mind is a logical man to direct intelligent thought toward stabilization of present conditions, and solving the greatest problem of the present age by his contribution to the problems of the county.

Acknowledgment.—Mr. Mavity, who is county engineer of Harvey County, Newton, Kansas, delivered this address before the second annual County Officials' Dinner at Detroit, Jan. 16, 1933.

▼

Ditch and Shoulder.

Cleaning weeds from the ditches and shoulder slopes should be done at least once in the spring and once in the fall. The spring cleaning should be done in the best judgment of the patrolman, weeds may be controlled to best advantage. If more than one spring cleaning is needed consult your Commissioner.

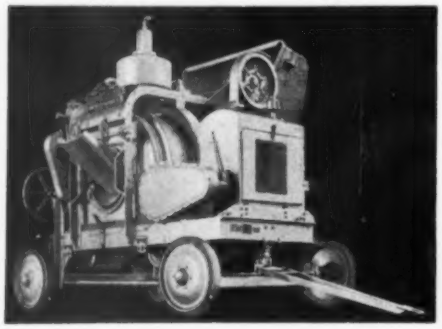
The cross-sections of some county highways becomes so deteriorated sometimes that it is economical to have a big grading outfit shape up the road for the patrolman. When this is deemed advisable consult Commissioner.

New Equipment and Materials

A New 10-S Drum Type Mixer

Construction Machinery Company, Waterloo, Iowa, has just announced a new Master 10-S mixer for 1933. This machine is lower, narrower and lighter and is extremely modern in design.

Anti-friction bearings are used at every vantage point. Drive is effected through high-speed roller chain running over machine cut sprockets in a bath of oil. Shafts are self-aligning which together with the



New Master 10-S Drum Type Mixer

other friction reducing features give the new Master 10-S a new smoothness of operation.

A new application of automotive steering is used which combines with full spring mounting and roller bearing wheels (either steel or rubber tired) to make this mixer a good trailer and exceptionally easy to spot on the job. The new Master 10-S is all-steel wherever practical, electric welded, hot riveted and bolted into a rigid unit. All working parts are carefully guarded. Controls are conveniently grouped at end of mixer for handy one-man operation. Alemite-Zerk lubrication throughout with fittings located to make greasing easy.

The Accurmeter calibrated water tank with dial indicator showing both pounds and gallons, and with improved duophase valve is standard equipment. This tank, it is stated, will split a pint and the valve is positively non-by-passing. A new timing device—the Mixometer—is available for jobs requiring this equipment.

An attractive bulletin on this Precision Built Two-Bagger will be sent gladly on request to Construction Machinery Company, or any of its distributors throughout the United States and Canada.

New Refuse Bodies for City of Baltimore Carry Larger Load

New refuse bodies recently purchased by the city of Baltimore are noteworthy because of their unusual capacity, low loading height and sanitary features.

These bodies are only 10 ft. long and fit a 2½-ton truck, but they have a capacity of 5 cu. yd. up to the loading line, and a total capacity of almost 7 cu. yd. fully loaded and with the sides closed. By the use of a special depressed floor, placing part of the load below the top of the chassis frame, the capacity has been increased without increase in overall size, making a compact body for use in congested streets, of a size suitable for the average city.

The loading height is only 60 in. from the street, within easy reach from the curb. One man can dump a loaded ash can into this body without help. The sides are fully enclosed, with a roll type of metal curtain so designed that any or all of the four sections can be opened or closed, as desired. When loading, both sides can be opened at one time for filling from both sides of the street; while, when running, the sides can be fully closed to prevent blowing of ashes or dropping of garbage. Another sanitary feature is the

New Trenton Refuse Collecting Body

water-tight floor and a tailgate, the latter of which is fitted with a gasket to eliminate drip. The floor is of heavy copper bearing steel, which resists the corrosive action of acids. A hoist operates the body for dumping. This Trenton refuse body is manufactured by Fitz Gibbon & Crisp, Inc., of Trenton, N. J.

New 2-Ton Motor Truck

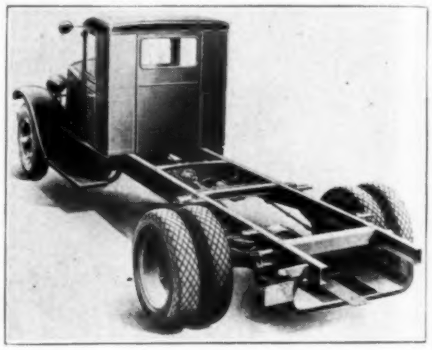
A new 6-cylinder 2-ton motor truck has been added to the line of the International Harvester Co., Chicago, Ill. It is available in three wheelbases, 145 in. for dump and semi-trailer service and 170 and 185 in. for general hauling.

The engine, which is of International Harvester design and manufacture, develops 63 brake horsepower at 3,200 r.p.m. Bore of cylinders is 3-7/16 in., piston stroke 4 in., and piston displacement 222.7 cu. in. Maximum torque of 154 pound-feet is developed at 800 r.p.m. Both horsepower and torque figures are with all accessories running. Among the outstanding features of the B-4 engine are its sturdy backbone—the heavy (69-lb.), counterbalanced four-bearing crankshaft; removable cylinders, which permit replacement of one or more cylinders without the expense of reboring; hardened exhaust-valve-seat inserts; full-force-feed lubrication; thermostatically controlled cooling system; downdraft carburetion, etc.

The 11-in., single-plate, vibration-dampened clutch, the four-speed transmission and the engine are mounted as a unit and are suspended at three points in the chassis. High road speed is possible in high or direct gear, while with the three lower reductions ample pulling ability is available for hill climbing and sandy or soft roads. Transmission reductions are: first or low, 6, 4 to 1; second, 3.09 to 1; third, 1.69 to 1; fourth or high, 1 to 1; and reverse, 7.82 to 1.

Ability easily to carry capacity loads and withstand distortion caused by road inequalities, is assured by an unusually strong frame of heavy pressed steel channels. These channels are 8 in. deep, and tapered at front and rear ends to provide low loading platform height. Heavy, channel-type cross members are gusseted to the side rails. Load-carrying capacity, with an ample factor of safety, is also provided in the full-floating spiral-bevel-drive rear axle by the use of a heavy, rigid, banjo-type, malleable-iron housing. The spiral-bevel pinion and driven gear, as well as differential gears, are of highest quality alloy steels. The pinion is straddle-mounted on ball bearings. Axle reductions are 5.625 to 1 and 6.5 to 1.

Included as standard equipment on the new B-4 2-ton International are semi-elliptic auxiliary rear springs which pro-



Chassis of Model B-4 Two-Ton Truck

vide ample spring capacity for heavy loads. Worthy of mention, also, are the propeller shafts, which are equipped with universal joints of new design known as the roller bearing, anti-friction type. Each wheelbase chassis is equipped with an intermediate shaft and three universal joints. A fully-enclosed ball bearing in a self-aligning housing supports the rear end of this intermediate shaft. Mechanically operated four-wheel service brakes are also standard equipment.

New Expansion Joint

A cork expansion joint for concrete construction has been placed on the market by the Bond Manufacturing Co., Wilmington, Del. The joint is made of carefully selected cork particles bound together with a phenol formaldehyde type resin. This combination is stated to possess all the permanent resiliency of cork wood, and in addition the chemical permanence of a synthetic resin.

New Motor Roller

A new 6-cylinder motor roller has been brought out by the Galion Iron Works & Mfg. Co., Galion, O. An important feature of this roller is an entirely new method of mounting front rolls and yoke on a spring supported king pin and the spring mounted engine and transmission, which includes differential, bull gears and rear axle.

The Galion Chief 6-Cylinder Motor Roller

Operation is easily handled by one man who need not leave the operating platform in performance of his duties. The master clutch lever, the forward and reverse clutch lever, the hand brake lever, the gear shift lever, the differential lock lever, the scarifier lever, together with the engine controls and indicating dials are located within close proximity to the steering wheel. All these controls are operable from a convenient, comfortable seat. The steering device is of the hydraulic type. An extra large and powerful hydraulic cylinder is located in the king pin head casting at front of frame and the piston rod of this cylinder is directly connected to a steering arm which is splined to top of king pin and permits free movement of the spring mounted king pin. Flow of oil to the steering cylinder is through a piston type valve.

Dash steering control is a smart molded automobile type steering wheel which drives an ingenious spiral cam which in turn operates the piston valve. Only a slight turn either way is necessary to open the valve. The hydraulic steering device is stated to be powerful enough to turn front rolls even when standing still and in soft material. It is stated also that the roller will turn in a 33 ft. circle, or will turn in an 18 ft. roadway by backing once.

The engine is a heavy duty industrial type 6-cylinder gasoline engine which develops 58 h.p. at 1,200 R.p.m. and is equipped with the following accessories to insure long life and the greatest economy of operation: Down draft carburetor, Vortex oil type air cleaner, governor adjusted from dash through a speed range from 700 to 1,200 r.p.m., distributor for battery ignition, and a fuel pump which makes it possible to place fuel tank at rear of frame under operator's platform. An electric starting motor and generator are also standard equipment. The roller is made in two sizes—10 and 12 tons. The speeds are: Low, 1.64 m.p.h.; intermediate, 3.44 m.p.h.; high, 5.90 m.p.h. Additional ranges of speed down to .85 m.p.h. in low obtained from the variable speed governor which is adjustable from operator's platform. The wheel base is 10 ft. 6 in., and the rolling width 6 ft. 4 in. with 20 in. rolls. The length over all with scarifier is 18 ft. 8 in.; without scarifier 17 ft. 2 in. The height overall is 6 ft. 6 in.

Universal Announces New Lorain 40-30

The Universal Crane Co., Lorain, O., has announced a new line of crawler shovel and crane equipment ranging from ¾-½-⅜ yd., known as the Lorain 40 and 30.

Containing many of the design and construction features of the Lorain line, produced by its parent company, the Thew Shovel Co., Universal now offers a complete line of machines of center drive design throughout plus a new development—balanced design. The working weight of the Lorain 40 as a ¾-yd. shovel is approximately 30,000 lb. and of the Lorain 30 as a ½-yd. shovel, approximately 23,000 lb.

The dippers on the units, and their crane ratings conform to the standards of the Shovel and Crane Manufacturers Association.

Balanced design is based on the theory that the shovel or crane capacity is dependent upon stability and strength rather than weight. In this new design the machinery frame is tilted toward the rear, thus all the turntable machinery has been grouped far back of the center pin so that it does double duty—it performs its operating functions, yet utilizes its own weight to counterbalance loads lifted. Tremendous strength is obtained through the use of modern alloy steels of nickel, molybdenum, chromium, manganeses and profuse heat treatment throughout. The Lorain 40 and 30 are built to the center drive principle of power transmission in crawler, turntable and shovel boom.

Shovel boom and dipper stick are of all-steel construction, the latter being a 7 in. one piece tube, a cross section which, per lineal weight per foot, gives the greatest resistance to the combined effects of torsional and bending strains. The center drive boom construction, with shipper shaft at center of the boom, aids in giving these units greater ranges. An automatic dipper trip is provided as standard equipment, a slight side pressure of the operator's elbow operating the device and utilizing engine power to dump the dipper.

Crane, clamshell and dragline booms are of single piece, all steel construction in 25, 30 and 35 ft. lengths with 5, 10 and 20 ft. extensions available for all types of booms. The dragline is equipped with a fairlead of new design, keeping the cable constantly on sheaves and permitting the front sheaves to pivot, thus maintaining a direct line to the bucket at all times. This is fastened to the front of the turntable between the boom feet. The tagline device is an automatically friction driven drum, which takes weight out of the boom and gives an opportunity to use the tagline effectively even on low boom, deep digging operations. Boom equipment is interchangeable, making the Lorain 40-30 available for use as shovel, crane, clamshell, dragline, backdigger, or skimmer.

The units are mounted on 2 speed center drive crawlers, 1½ m.p.h. (16½ per cent grade) at high speed, ¾ m.p.h. (35 per cent grade) at low speed. Speeds are available

New Lorain 40

in both directions. Steering is controlled by a single hand lever regardless of turntable swing position, and permits pivot or long radius turns in either direction. The end axle design is such that the shovel dipper may be drawn in against the crawler base to start the digging cycle.

Units are powered by 6-cylinder Waukesha motors, the Lorain 40 with a ML motor, 4 in. x 4¾ in., developing 52 h.p., the Lorain 30 with a TL motor, 3⅜ in. x 4¾ in., 43 h.p. Impulse coupled magneto, radiator, fan, oil filter and air cleaner are standard equipment.

All levers, controlling complete operation of the machine, are conveniently grouped at the operator's position at the front of the platform where the operator has a wide range of vision to either side or vertically for high booms. Operator and mechanism are well protected by an all steel cab, gear guards and dust covers. A full enclosure is also available, featuring a safety door latch for quick release by the operator. The cab has been given modern streamlines to make a very attractive appearance, accentuated by two color paint design to rival the modern automobile in impression of speed and beauty.

Vibrator Unit for Loaders and Conveyors

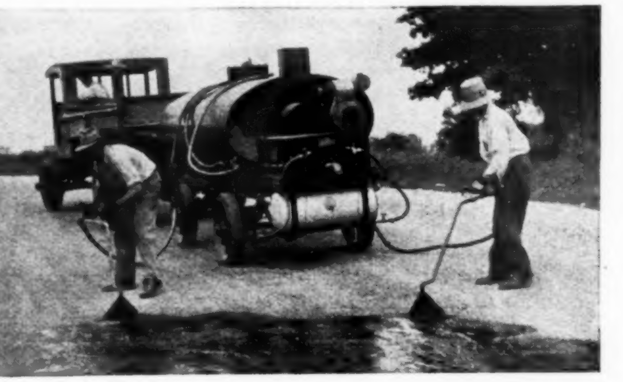
A small and compact single-deck vibrator, 36 in. wide and 58 in. long, of all steel construction and weighing approximately 450 lb., for use at ends of portable conveyors and loaders, or in place of plain gravity screens at points of discharge from bins, has been placed on the market by the Universal Vibrating Screen Co. of Racine, Wis. The accompanying cut shows one of these units installed on a portable conveyor. It weighs but little more than the average plain gravity screen chute, such as have been used in those positions heretofore, it is easily installed and the cost is low.

Vibrator Unit Installed on Portable Conveyor

Improvements in design and construction have also been adopted on the Type "M" heavy duty double deck screens manufactured by this company, and they report increased sales on this model also. Descriptive literature covering their entire line of screens, will gladly be mailed to anyone interested.

New Bituminous Spraying Unit

A new unit that can be used for distributing bituminous material on small surfacing jobs, or as a maintenance unit, or as a supply tank for pressure distributors, has been placed on the market by Littleford Bros., 454 E. Pearl St., Cincinnati, O.



The Littleford Utility Spray Tank in Action with Two Spray Bars Attached. Flow of Material Is Controlled at Spray Bar; When Shut Off, Material Is By-Passed Back to Tank

The outfit is stated to be particularly useful on such work as patching, widening curves, relocating turns, repairing land slides and resurfacing ditches made by public utilities. It can also be used for surface treatment and shoulder work. The outfit also can be used as a supply tank in conjunction with a pressure distributor.

The spraying unit consists of an air-cooled engine, rotary gear pump, one 25-ft. length of 1¼ in. flexible metal hose and spray bar. (Outfit can be provided with double outlet—two sprays can be used at the same time. There is a small additional charge for extra hose and spray bar.) Wide spray bars with two or more spray tips can be furnished and are recommended when the outfit is to be used extensively for surface treatment. Special valve arrangement controls flow of bitumen. Operator can regulate the valve to pump material from tank car to spray tank, from spray tank to kettles or distributors. He can regulate it to circulate material through the tank, In fact, the outfit can fill, spray, circulate and drain just like a pressure distributor. In addition, bitumen can be drained from the tank without passing through pump or valve. Asphalt, tar, road oil, cut-back, or emulsion are handled equally well. If outfit is wanted for use only as a supply tank, spraying equipment is eliminated.

Two sets of heat distributing flues, made of 5 in. pipes, pass from rear to front and back to rear of tank. Tubes are properly supported to allow for expansion and contraction. (Outfit can be furnished without heat tubes if it is to handle material that does not require heat.)

Heat is generated by two LB torch-type oil burners which are fully protected from wind by a special windshield. Material can be heated while outfit is being moved at high speeds. Fuel is supplied to burner under pressure from a 30 gal. fuel tank. Hose connections are standard between burners and fuel tank; pipe conections furnished when requested.

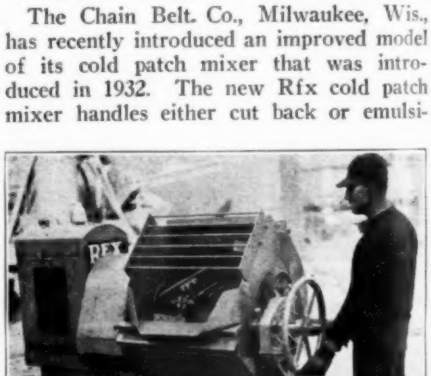
An exhaust manifold covers the rear head of the tank and encloses pump and piping, keeping these parts thawed out and in operating condition. A large inspection door is directly above pump.

No. 101 tank is oval in shape, giving a low center of gravity. It is of welded construction with a steel baffle plate inside to reduce surging of liquid bitumen. All seams are tested and guaranteed to be leakproof. Standard outfits are not insulated. If insulation is required, 1 in. rock wool with an outside covering of sheet steel will be provided.

Littleford Bros. furnish the tank mounted on their standard trailer or unmounted; therefore, if the highway department or contractor has a truck or trailer on which to mount the tank, it may be ordered unmounted. For further information, write to Littleford Bros.

New Cold Patch Mixer

The Chain Belt Co., Milwaukee, Wis., has recently introduced an improved model of its cold patch mixer that was introduced in 1932. The new Rfx cold patch mixer handles either cut back or emulsified asphalt. It is claimed the new unit will mix a batch of emulsified asphalt in 20 seconds, supplying first the mixing action necessary to do a thorough job, and, secondly, doing it in so short a time that the emulsion is perfected—not broken down as frequently happens in longer mixing cycles.



Rex Cold Patch Mixer

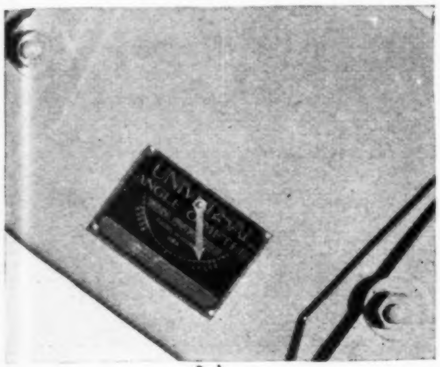
It also is stated that on cut back asphalt it will do the mixing in 45 seconds.

This new unit is of the Rex pug mill design and is equipped with a factory built-in heater. The heater is an integral part of the machine, but is quickly detachable and may be removed and used for heating the oil before putting it into the mixer.

The Rex cold patch mixer has a capacity of 4 to 6 cu. ft. of mixed material, depending upon the type of asphalt and aggregate used, and is equipped with an easy dump band wheel that makes charging and discharging an easy job.

Device for Securing Proper Operating Angle of Vibrating Screens

In the accompanying illustration, a device is shown which is attached in a prominent position on the side members of all late model universal vibrating screens. It has been named "Angle-O-Meter," by the Universal Vibrating Screen Co. of Racine, Wis., as their engineers designed



The Angle-O-Meter

it for service on all of the various sizes and types of screens they manufacture.

When a Universal screen is installed, one end of the machine is raised until the pointer, or pendulum on the "Angle-O-Meter," reaches the recommended degree of pitch, or operating angle, and in this way all errors of installation, with resultant loss of screening efficiency, are eliminated.

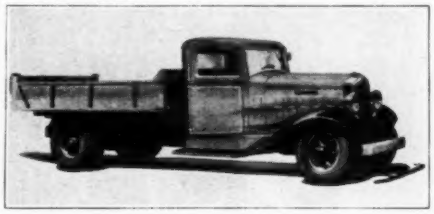
New Federal Trucks

A feature of the truck exhibit of the Federal Motor Truck Co., Detroit, Mich., at the recent Road Show in Detroit, was a 1933 model 3-ton dual drive 6-wheeler.

Federal's new models are distinctive in appearance. The long stream-line hood and cowl, with ventilating doors; artistic chromium-plated, slanting V-type radiator with handsome grill; wide, sweeping fenders; heavy chromium-plated bumper; extra large chromium-plated head-lamps, and twin disc chromium-plated horns, are among the features which contribute to the outstanding style of the six-wheeler, as well as other 1933 Federal models.

A point particularly emphasized by the manufacturer of this six-wheel equipment is that it is produced as a single unit of transportation—the six-wheel feature *is not an attachment.* The complete vehicle is built by Federal and guaranteed by Federal.

Shown in the accompanying illustration is another of Federal's 1933 models exhibited at the Road Show—a 3½ to 4-tonner, with a gross rating of 18,000 lb. Mounted on this Federal chassis is a practical dump body for general construction work. Varied



New Federal 3½ to 4-Ton Truck

sizes and types of dump equipment for this chassis are available.

Eighty-five horsepower at 2,400 r.p.m. is developed by the heavy-duty 6-cylinder, 7-bearing engine. A Blue flame manifold automatically proportions heat and equalizes distribution of the charge. Water jacket, extending the full length of piston travel, controls the circulation of water and distributes cool water first to the valve seats where extra cooling is needed. Incorporated with the air cleaner is an intake silencer, which removes practically all carburetor noise at high or low speeds. Clutch is single plate 13 in. heavy-duty truck type. The special spring type dry disc is an important factor in absorbing vibration. Requirements for a broad range of power and speed are fully met by the easy-shifting five-speed transmission with exceptionally quiet fourth as well as fifth speed.

Universal joints are roller bearing type. Lubricant is retained in roller bearings by cork seal, and lubrication is needed only every 25,000 miles. Service brakes are four-wheel hydraulic, fully enclosed, power-operated. Emergency brake is Tru-Stop single shoe ventilated disc type. Ventilating feature provides for cool air circulation, assuring long life of brake linings and more dependable braking action.

The chassis frame is fish belly type with 10 in. section at the deepest part. Frame side rails are ¼ in. thick with 3½ in. flanges. Front springs are shackled at the front, which adds stability to steering and handling of the vehicle. Rear end of rear spring is floating contact type, sliding on frame brackets, eliminating shackles, spring pins, bushings and the necessity of lubrication. Rear spring is the Hotchkiss type of drive. Auxiliary springs are standard equipment.

Simple Car Unloading Rig of Quick Portability

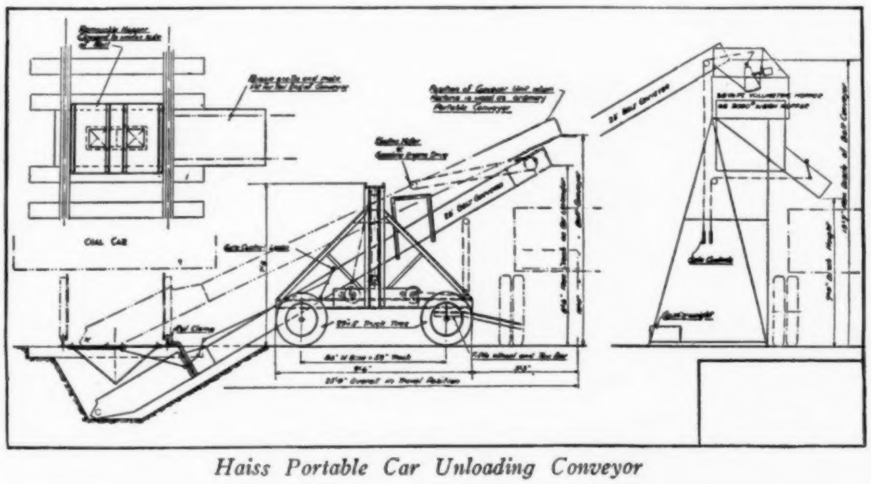
A special portable car unloading conveyor of standardized design and sizes has been brought out by George Haiss Manufacturing Co., New York. The accompanying illustration diagrams the set-up of this unit and its use with various auxiliaries.

The machine is mounted on four rubber-tired wheels so that it can be hauled behind a truck at ordinary road speeds and spotted in position as desired. The conveyor boom is supported by a structural steel A-frame, with a raising and lowering device so arranged that the machine may be used with the tail either in a track pit, or level with the ground.

For most completely automatic operation the complete equipment includes a steel hopper that can be placed between the tracks, with a feeding gate and controls to regulate the flow of material to the conveyor. By the simple removal of one tie, a pit can be made for the tail end of the conveyor and the use of this loading hopper. The latter is very necessary to prevent too great a flow of material from the hopper bottom car. The gate control is carried to the side of the Haiss conveyor, where it and all other controls are within easy reach of the operator.

The length of conveyor may be 25, 30 or 35 ft. as required to give proper truck clearance under the discharge end. It is to be noted in the illustration that Haiss also provides a batch measuring hopper which, with the 35 ft. conveyor unit, provides a means of loading batch trucks with aggregates proportioned either by weight or by volume. The measuring hopper, on a rigidly braced, structural steel supporting frame may be either a 30 cu. ft. volumetric hopper, or a weighing hopper of 3,000 lbs. maximum batch capacity.

The manufacturer is prepared to furnish a detailed description of this unloading rig in its adaptation to any given operating condition.



Haiss Portable Car Unloading Conveyor

Distributor News

Ginsberg, Barnes & Conway, Inc., Organized

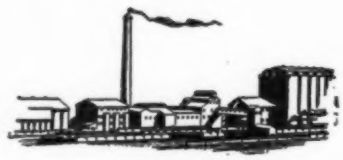
Frank Ginsberg, Don Barnes, Jack Conway, and Bob Campello have joined forces for the sale of construction and engineering equipment under the firm name of Ginsberg, Barnes & Conway, Inc. The offices, warehouse and service station are located at 355 Walton Ave., Bronx, New York City. All these men have been engaged in the construction machinery business in this territory for a good many years. They represent exclusively these well known manufacturers: Butler Bin Co., Waukesha, Wis.; Byers Machine Co., Ravenna, O.; Chain Belt Co., Milwaukee, Wis., and Smith Engineering Works, Milwaukee. A complete stock of repair parts and expert mechanics are available at their plant. Frank Ginsberg is an expert on concrete handling equipment, including the Rex pumpcrete (concrete pump), bulk cement handling equipment and the application of shovels, cranes and excavators. Don Barnes has made a life study of the design and application of sand and gravel plant and quarry plant machinery. Jack Conway was brought up in the concrete mixer industry and has specialized in equipment for the general contractor and builder. Bob Campello is the auditor. His past experience has given him a thorough understanding of the contractors' financial problems. L. H. Burt is representing the organization on Long Island, and R. D. (Buck) Weaver in New Jersey. Both Burt and Buck are experienced construction machine men.

Henry K. Potter Is Dead

Henry K. Potter, for 19 years manager of the Municipal Department of the Kinney Manufacturing Co., Boston, Mass., passed away at his home in Somerville on Friday, Feb. 17. Mr. Potter was very well known in the various road builders' associations and throughout this class of industry. Before coming with the Kinney Manufacturing Co. in 1913 he was for about 20 years connected with the Studebaker Corporation. About a year ago he retired from active business, and his final illness was caused by heart trouble. He is survived by his wife, two sons, and a married daughter.

Mohawk Asphalt Heater Company Moves Into New Quarters

The Mohawk Asphalt Heater Co., for many years located at Schenectady, N. Y., announces the removal of its factory and general offices to a new, modern building at Frankfort N. Y., on or about March 1. The new plant is up to date in every respect, and will house factory, warehouse, showroom and offices under one roof. It is of steel and concrete construction, with



wire glass, steel-sash windows on all sides, giving plenty of light and air. Straight line production methods will be used throughout, in the new factory, giving a steady progression of processes from raw material to finished product, and it is hoped by the management that with the more modern setup, Mohawk will be in better position than ever to serve its customers throughout the nation. Mohawk will continue to manufacture the "Hotstuf" asphalt heater; "Hotstuf" tool, asphalt and surface heaters; Mohawk improved torch type oil burners; concrete heaters, salamanders and water heaters; Mohawk hi-speed tool and supply trailers; Mohawk pole anl pipe trailers; and other allied products. With the more modern manufacturing facilities, and plenty of room for expansion, it is planned to add new lines as conditions improve and their need becomes apparent.

Calcium Chloride Association Organized

Organization of the Calcium Chloride Association with offices at 4200 Penobscot Bldg., Detroit, Mich., was announced today. Members include the Solvay Sales Corporation, the Dow Chemical Co., the Michigan Alkali Co. and the Columbia Alkali Corporation. The association also announced the appointment of Ray A. Giddings of Barberton, O., as secretary. Mr. Giddings formerly was manager of special product sales for the Columbia Alkali Corporation. Previously for a number of years he was with the Minnesota State Highway Department. He will supervise the Association activities including advertising, research and promotion of the various uses of calcium chloride. The Calcium Chloride Association succeeds the Calcium Chloride Publicity Committee, formed by the same interests in 1928 to promote the interests of the calcium chloride industry. N. W. Ayer & Son, Inc., Philadelphia, has been appointed advertising counsel for the association.

American Cable Company Licenses Williamsport

Williamsport Wire Rope Co. recently has been added to the long list of wire rope manufacturers licensed to manufacture Preformed Wire Rope under the American Cable Co.'s patents. The other American concerns who are licensed to make Preformed Wire Rope are: American Steel & Wire Co., Broderick & Bascomb Rope Co., E. H. Edwards Co., General Cable Corporation, Hazard Wire Rope Co., MacWhyte Co., Pacific Wire Rope Co., Wickwire Spencer Steel Co., Wire Rope Mfg. & Equipment Co.

Penn Machinery Co. Distributor for Marion

The Marion Steam Shovel Co., Marion, O., has announced the appointment of the H. O. Penn Machinery Co., 140th St. and East River, New York City, as distributor for Marion products in Greater New York, Albany, Long Island and Northern New Jersey. A complete stock of repair parts for all Marion machines having a capacity of less than 2 cu. yds. will be carried at their warehouse to provide immediate service to users in the above territory. The district office of the Marion Steam Shovel Co., located at 3305 Chrysler Bldg., New York City, and its entire personnel, will be continued as heretofore.

Eibell Leaves Worthington

Mr. F. C. Eibell, who for the past four years has been manager of the advertising and publicity department of the Worthington Pump and Machinery Corporation, New York, N. Y., has resigned. He brought to Worthington a well-rounded advertising, merchandising, sales promotion and pubilicity experience. He has had executive assignments on the staffs of three advertising agencies, two publishers and three manufacturers' advertising departments. His work during the past four years marked Worthington as one of the outstanding industrial advertising accounts. No announcement has been made concerning his future plans.

Thomas Elevator Co. Changes Name

The Thomas Elevator Co., 20 S. Hoyne Ave., Chicago, announces that it has changed its name to Thomas Hoist Co. This means no change in ownership, management or personnel. The change in name is for obvious reasons. The principal business is and always has been the manufacture of electric, steam and gasoline hoists. The business of leasing hoists will be conducted by a division of the Thomas Hoist Co.

Holmes Enters Employ of Inland Steel

Howard A. Holmes has been employed by the Inland Steel Co. and will be in the company's sales department at their Detroit, Mich., office. During the past year Mr. Holmes has served as assistant district sales manager for the Weirton Steel Co. in Chicago, and prior to that time he was located in the sales office of this company at Detroit.